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10           **UNIVERSAL REMOTE INCLUDING APPARATUS USING  
              COMPRESSED CODES FOR VIDEO RECORDER CONTROL**

**Background of the Invention**

15           This is a continuation in part of pending Patent  
              Application Serial No. 07/965,075 filed October 22, 1992,  
              which is a continuation of pending Patent Application  
              Serial No. 07/877,687 filed May 1, 1992, now abandoned,  
              which is a continuation in part of Patent Application  
20           Serial No. 07/829,412 filed February 3, 1992, which is a  
              continuation in part of Serial No. 07/767,323 filed  
              September 30, 1991, which is a continuation in part of  
              Serial No. 07/676,934 filed March 27, 1991, which is a  
              continuation in part of Serial No. 07/371,054 filed  
25           June 26, 1989, now abandoned, which itself is a  
              continuation in part of Serial No. 07/289,369, filed  
              December 23, 1988, now abandoned.

**Field of the Invention**

30           This invention relates generally to video cassette  
              recorder systems and particularly to an apparatus and  
              method for using encoded information to shorten the time  
              required to perform timer preprogramming and for remotely  
              controlling various home electronic devices and an  
              alternate apparatus and method that itself is easily  
35           programmable.

1     Prior Art

      The video cassette recorder (VCR) has a number of  
uses, including playing back of tapes filmed by a video  
camera, playing back of pre-recorded tapes, and recording  
5     and playing back of broadcast and cable television  
      programs.

      To record a television program in advance of viewing  
it, a two-step process is often used: (1) obtain the  
correct channel, date, time and length (CDTL) information  
10    from a television program guide, and (2) program this CDTL  
      information into the VCR. Depending on the model, year  
and type of the VCR, the CDTL information can be  
programmed in various ways including: (i) pushing an  
appropriate sequence of keys in the console according to  
15    instructions contained in the user's manual, (ii) pushing  
      an appropriate sequence of keys in a remote hand-held  
control unit according to instructions contained in the  
user's manual (remote programming), and (iii) executing a  
series of keystrokes in the remote hand-held control unit  
20    in response to a menu displayed on the television screen  
      (on-screen programming). Other techniques for timer  
preprogramming have been suggested including: (iv) reading  
in certain bar-code information using a light pen (light  
pen programming), and (v) entering instructions through a  
25    computer or telephone modem. These various methods differ  
      only in the physical means of specifying the information  
while the contents, being CDTL and certain  
power/clock/timer on-off commands are generally common,  
although the detailed protocol can vary with different  
30    model VCRs. Methods (i) and (ii) described above can  
      require up to 100 keystrokes, which has inhibited the free  
use of the timer preprogramming feature of VCRs. To  
alleviate this, new VCR models have included an "On-Screen  
Programming" feature, which permits remote input of CDTL  
35    information in response to a menu displayed on the  
      television screen. Generally on screen programming of  
CDTL information requires an average of about 18

1        keystrokes, which is less than some of the prior methods  
but still rather substantial. Some of the other  
techniques such as (iv) above, require the use of special  
equipment such as a bar code reader.

5        In general the present state of the art suffers from  
a number of drawbacks. First, the procedure for setting  
the VCR to record in advance can be quite complex and  
confusing and difficult to learn; in fact, because of this  
many VCR owners shun using the timer preprogramming record  
10       feature. Second, the transcription of the CDTL  
information to the VCR is hardly ever error-free; in fact,  
many users of VCR's timer preprogramming features express  
concern over the high incidence of programming errors.  
Third, even for experienced users, the process of entering  
15       a lengthy sequence of information on the channel, date,  
time and length of desired program can become tedious.  
Fourth, techniques such as reading in bar-code information  
or using a computer require special equipment. These  
drawbacks have created a serious impedance in the use of  
20       a VCR as a recording device for television programs. The  
effect is that time shifting of programs has not become as  
popular as it once was thought it would be. Accordingly,  
there is a need in the art for a simpler system for  
effecting VCR timer preprogramming which will enable a  
25       user to take advantage of the recording feature of a VCR  
more fully and freely.

#### Summary of the Invention

30       A principal feature of the invention is providing an  
improved system for the selection and entering of channel,  
date, time and length (CDTL) information required for  
timer preprogramming of a VCR which is substantially  
simpler, faster and less error-prone than present  
techniques. Another principal feature of the invention is  
35       providing televisions having an embedded capability for  
timer programming control.

1 In accordance with the invention, to program the  
timer preprogramming feature of a video system, there is  
an apparatus and method for using encoded video  
recorder/player timer preprogramming information. The  
5 purpose is to significantly reduce the number of  
keystrokes required to set up the timer preprogramming  
feature on a VCR. In accordance with this invention it is  
only necessary for the user to enter a code with 1 to 7  
10 digits or more into the VCR. This can be done either  
remotely or locally at the VCR. Built into either the  
remote controller or the VCR is a decoding means which  
automatically converts the code into the proper CDTL  
programming information and activates the VCR to record a  
15 given television program with the corresponding channel,  
date, time and length. Generally multiple codes can be  
entered at one time for multiple program selections. The  
code can be printed in a television program guide in  
advance and selected for use with a VCR or remote  
controller with the decoding means.

20 Another principal object of the invention is to embed  
the decoding means into a television. The television  
would then at the appropriate time distribute the proper  
commands to a VCR and a cable box to record the desired  
program. The user would use the television remote or  
25 controls on the television to enter the code that  
signifies the program to be recorded. The same television  
remote and controls on the television would also be used  
to perform normal television control functions, such as  
channel selection. When the codes are entered they are  
30 transmitted to the television and the decoder in the  
television, which decodes the codes into CDTL information  
and then the codes themselves and the CDTL information  
could be displayed "on screen" so that the user can verify  
that the proper codes have been entered. Then at the  
35 appropriate time the television would transmit the proper  
commands to a VCR and a cable box, if necessary, to  
command the recording of the selected program. This

1 control function can be carried out by using an infrared  
link by placing infrared transmitters on the television  
cabinet, preferably at the corners. The television  
circuitry would include the capability of storing or  
5 learning the infrared code protocols for the VCR and the  
cable box.

Another principal object of the invention is to embed  
the decoding means into various equipments associated with  
television, such as a video cassette recorder, cable box  
10 or satellite receiver. In any system the decoding means  
would only have to be present in one of the equipments,  
such as the cable box, which would then at the appropriate  
time distribute the proper commands to the other  
equipments such as a VCR and a satellite receiver to  
15 record the desired program. The user would use the  
television remote or controls on the equipment with the  
decoder to enter the code that signifies the program to be  
recorded. The same television remote would also be used  
to perform normal television control functions, such as  
20 channel selection. When the codes are entered they are  
transmitted to the equipment with the decoder, which  
decodes the codes into CDTL information. Then at the  
appropriate time the equipment with the decoder would  
transmit the proper commands to a the other equipment such  
25 as a VCR, satellite receiver and a cable box to command  
the recording of the selected program. This control  
function can be carried out by using an infrared link by  
coupling infrared transmitters on the equipment with the  
decoder. The infrared transmitter can be placed in a  
30 infrared dome on the equipment, mounted behind the front  
panel, attached to a mouse coupled via a cable to the  
equipment with the decoder with the mouse placed near the  
receiver, or attached to a stick on miniature mouse  
coupled via a cable to the equipment with the decoder with  
35 the miniature mouse attached to the device with the  
receiver. The equipment with the decoder would include  
the capability of storing or learning the infrared code

1 protocols for the other equipment, such as a VCR,  
satellite receiver and a cable box.

Another embodiment of the invention includes a full  
function universal remote control capable of controlling  
5 various home electronic devices. The functions of the  
buttons of the remote control and the infrared codes  
needed to perform the functions are programmed remotely,  
such as by transmissions over telephone lines received by  
a microphone in the remote control.

10 Other objects and many of the attendant features of  
this invention will be more readily appreciated as the  
same becomes better understood by reference to the  
following detailed descriptions and considered in  
connection with the accompanying drawings in which like  
15 reference symbols designate like parts throughout the  
figures.

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1     Brief Description of the Drawings

FIG. 1 is a schematic showing apparatus according to this invention with the code decoder means embedded in the video cassette recorder;

5     FIG. 2 is a schematic of the VCR embedded processors for command control and code decoding;

FIG. 3 is a schematic showing a preferred embodiment according to this invention with the code decoder means embedded in a remote controller;

10    FIG. 4 is a schematic of the processor embedded in the remote controller;

FIG. 5 is a schematic of a universal remote controller with the code decoder means embedded in the universal remote controller;

15    FIG. 6 is a flow graph of the G-code decoding technique;

FIG. 7 is a flow graph of the G-code encoding technique;

20    FIG. 8 is an illustration of part of a television calendar according to this invention;

FIG. 9 is a flow chart for decoding for cable channels;

25    FIG. 10 is a flow chart for encoding for cable channels;

FIG. 11. is a flow graph of the G-code decoding for cable channels including conversion from assigned cable channel number to local cable carrier channel number;

30    FIG. 12 is a means for decoding including a stack memory;

FIG. 13 is a flow chart for program entry into stack memory;

FIG. 14 is an operation flow chart for sending programs from remote control to main unit VCR;

35    FIG. 15 is a perspective view of an apparatus for using compressed codes for recorder preprogramming according to a preferred embodiment of the invention;

1        FIG. 16 is a front view of the apparatus of FIG. 15  
showing a forward facing light emitting diode;

FIG. 17 is a perspective view of the apparatus of  
FIG. 15 placed in a mounting stand;

5        FIG. 17A is a front elevational view of the apparatus  
of FIG. 15 placed in the mounting stand as shown in  
FIG. 17;

FIG. 18 is a detail of the LCD display of the  
apparatus of FIG. 15;

10       FIG. 19 is a perspective view showing a manner of  
placing the apparatus of FIG. 15 relative to a cable box  
and a VCR;

FIG. 20 is a perspective view showing a manner of  
placing the mounting stand with the apparatus of FIG. 15  
mounted thereon near a cable box and VCR;

15       FIG. 21 is a schematic showing apparatus for using  
compressed codes for recorder preprogramming according to  
a preferred embodiment of the invention;

FIG. 22 is a detailed schematic showing a preferred  
embodiment of apparatus implementing the schematic of  
FIG. 21;

20       FIG. 23 is a flow graph for program entry into the  
apparatus of FIG. 15;

FIG. 24 is a flow graph for review and program  
cancellation of programs entered into the apparatus of  
FIG. 15;

25       FIG. 25 is a flow graph for executing recorder  
preprogramming using compressed codes according to a  
preferred embodiment of the invention;

30       FIG. 26 is a flow graph for encoding program channel,  
date, time and length information into decimal compressed  
codes;

FIG. 27 is a flow graph for decoding decimal  
compressed codes into program channel, date, time and  
length information;

35       FIG. 28 is an embodiment of an assigned channel  
number/local channel number table;



1        FIG. 29 block diagram of a system including a television having a G-code decoder;

      FIG. 30 is a schematic of a television having a G-code decoder;

5        FIG. 31 is a schematic showing apparatus for a G-code decoder in a television having G-code decoding;

      FIG. 32 is a block diagram of a system including a television having a G-code decoder, a VCR, a cable box and a satellite receiver;

10       FIG. 33 is a block diagram of a system including a VCR having a G-code decoder, a television, a cable box and a satellite receiver;

      FIG. 34 is a block diagram of a system including a cable box having a G-code decoder, a television, a VCR, and a satellite receiver;

15       FIG. 35 is a block diagram of a system including a satellite receiver having a G-code decoder, a television, a VCR, and a cable box;

20       FIG. 36 is a perspective view showing a cable box placed on top of a VCR having an infrared transmitter behind the front panel which communicates to the cable box infrared receiver via reflection;

      FIG. 37 is a perspective view showing a cable box placed on top of a VCR having an infrared transmitter inside a infrared dome on the top of the VCR which communicates to the cable box infrared receiver;

25       FIG. 38 is a perspective view of a VCR having an infrared transmitter inside a mouse coupled via a cable to the VCR with the mouse placed near the cable box infrared receiver; and

30       FIG. 39 is a perspective view of a VCR having an infrared transmitter inside a miniature mouse coupled via a cable to the VCR with the miniature mouse stuck onto the cable box near the infrared receiver.

35       FIG. 40 is a perspective view of a second apparatus for using compressed codes for recorder preprogramming according to a preferred embodiment of the invention.

1           FIG. 41 is a bottom view of the apparatus of FIG. 41 showing a microphone hole and two electrical contact holes.

5           FIG. 42 shows the apparatus of FIG. 40 being used in conjunction with a telephone.

          FIG. 43 is a schematic showing second apparatus for using compressed codes for recorder preprogramming according to a preferred embodiment of the invention.

10          FIG. 44 is an alternate schematic showing second apparatus for using compressed codes for recorder preprogramming according to a preferred embodiment of the invention.

15          FIG. 45 is a perspective view of an apparatus for programming remote controls with memories according to a preferred embodiment of the invention.

          FIG. 46 is a perspective view of the apparatus of FIG. 45 with the hinged lid in the open position.

          FIG. 47 is a rear view of the apparatus of FIG. 45 showing telephone and computer input/output ports.

20          FIG. 48 is a bottom view of the apparatus of FIG. 15 showing electrical contact access holes.

          FIG. 49 is a perspective view of the apparatus of FIG. 45 coupled to an apparatus according to FIG. 15.

25          FIG. 50 is a perspective view of the apparatus of FIG. 45 coupled to an apparatus according to FIG. 40.

          FIG. 51 is a schematic showing apparatus for programming remote controls with memories according to a preferred embodiment of the invention.

30          FIG. 52 is a schematic showing the electronic connection between apparatus for programming remote controls with memories according to a preferred embodiment of the invention and a personal computer.

35          FIG. 53 is a perspective view of a complete universal remote control capable of using compressed codes for recorder preprogramming according to a preferred embodiment of the invention.

          FIG. 54 is a front view of the apparatus of FIG. 53.

1        FIG. 55 is a side view of the apparatus of FIG. 53  
showing a microphone opening and an electrical contact  
access hole.

FIG. 56 is a rear view of the apparatus of FIG. 53.

5        FIG. 57 is a back view of the apparatus of FIG. 53  
showing electrical contact access holes.

FIG. 58 is a block schematic of an embodiment of the  
apparatus of FIG. 53.

10       FIG. 59 is a block schematic of an alternative  
embodiment of the apparatus of FIG. 53.

FIG. 60 is a flow chart of the process of remotely  
programming the apparatus of FIG. 53 over telephone lines.

15       FIG. 61 shows the apparatus of FIG. 53 in its upright  
position, resting on a coffee table on the apparatus' rear  
surface.

FIG. 62 is a cross sectional view taken along line  
7-7 of FIG. 53.

FIG. 63 is a cross sectional view taken along line  
8-8 of FIG. 53.

20       FIG. 64 is a cross sectional view taken along line  
9-9 of FIG. 53.

FIG. 65 is a perspective view of an alternative  
embodiment of the remote control of FIG. 53.

25       FIG. 66 is a top view of the remote control of  
FIG. 65.

FIG. 67 is a side view of the remote control of  
FIG. 65.

FIG. 68 is a front view of the remote control of  
FIG. 65.

30       FIG. 69 is a rear view of the remote control of  
FIG. 65.

FIG. 70 is a bottom view of the remote control of  
FIG. 65.

35       FIG. 71 is a perspective view of a second alternative  
embodiment of the remote control of FIG. 53.

FIG. 72 is a top view of the remote control of  
FIG. 71.

1        FIG. 73 is a side view of the remote control of  
FIG. 71.  
      FIG. 74 is a rear view of the remote control of  
FIG. 71.  
5        FIG. 75 is a front view of the remote control of  
FIG. 71.  
      FIG. 76 is a bottom view of the remote control of  
FIG. 71.

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1     Detailed Description

          Referring now to the drawings, and more particularly,  
to FIG. 1, there is shown an apparatus for using encoded  
video recorder/player timer preprogramming information 10  
5     according to this invention. The primary components  
include a remote controller 12 and a video cassette  
recorder/player with G-code decoder 14, which can be  
controlled by remote controller 12 via a command signal  
16. The remote controller 12 can have a number of keys,  
10     which include numerical keys 20, G-code switch 22,  
function keys 24, program key 26 and power key 27. There  
are means in the remote controller 12 that interprets each  
key as it is pressed and sends the proper command signal  
16 to the VCR via an infra-red light emitting diode 28.  
15     Except for the G-code switch 22 on the remote controller  
12 in FIG. 1, the remote controller 12 is essentially the  
same as any other remote controller in function. The  
G-code switch 22 is provided just to allow the user to  
lock the remote controller 12 in the G-code mode while  
20     using a G-code, which is the name given to the compressed  
code which is the encoded CDTL information, to perform  
timer preprogramming.

          A G-code consists of 1 to 7 digits, although more  
could be used, and is associated with a particular  
25     program. A user would look up the G-code in a program  
guide and just enter the G-code on the remote controller  
12, instead of the present state of the art, which  
requires that the user enter the actual channel, date,  
time and length (CDTL) commands.

30     In order to understand the advantages of using a  
G-code, it is helpful to describe the best of the current  
state of the art, which is "on screen programming" with  
direct numerical entry. This technique involves about 18  
keystrokes and the user has to keep switching his view  
35     back and forth between the TV screen and the remote  
controller while entering the CDTL information. This  
situation may be akin to a user having to dial an 18 digit

1 telephone number while reading it from a phone book. The  
number of keys involved and the switching back and forth  
of the eye tend to induce errors. A typical keying  
sequence for timer recording using on-screen CDTL  
5 programming is as follows:

PROG 2 1 15 07 30 2 08 00 2 04 PROG

10 The first program (PROG) key 26 enters the programming  
mode. Then a sequence of numerical keys 20 are pushed.  
The 2 means it is timer recording rather than time  
setting. The 1 means the user is now entering the  
settings for program 1. The 15 is the date. The 07 is  
15 starting hour. The 30 is a starting minute. The 2 means  
pm. The next sequence 08 00 2 is the stopping time. The  
04 is channel number. Finally, the PROG is hit again to  
exit the program mode.

By contrast, this command could have been "coded" and  
entered in a typical G-code sequence as follows: PROG  
20 1138 PROG. To distinguish that the command is a coded  
G-code, the G-code switch 22 should be turned to the "ON"  
position. Instead of having a switch, a separate key "G"  
can be used. The G-code programming keystroke sequence  
would then be: G 1138 PROG.

25 The use of a G-code does not preclude "on-screen"  
confirmation of the program information that has been  
entered. When the keystrokes "PROG 1138 PROG" are entered  
with the G-code switch in the "ON" position, the G-code  
30 would be decoded and the television could display the  
following message:

PROGRAM	DATE	START TIME	STOP TIME	CHANNEL
1138	15	7:30 PM	8:00 PM	4

35 In order for the G-code to be useful it must be  
decoded and apparatus for that purpose must be provided.  
Referring to FIG. 1, a video cassette recorder/player with

1 G-code decoder 14 is provided to be used in conjunction  
with remote controller 12. The command signal 16 sent  
from the remote controller 12 is sensed by the photodiode  
32 and converted to electrical signals by command signal  
5 receiver 30. The electrical signals are sent to a command  
controller 36, which interprets the commands and  
determines how to respond to the commands. As shown in  
FIG. 1, it is also possible for the command controller 36  
to receive commands from the manual controls 34 that are  
10 normally built into a VCR. If the command controller 36  
determines that a G-code was received then the G-code will  
be sent to the G-code decoder 38 for decoding. The G-code  
decoder 38 converts the G-code into CDTL information,  
which is used by the command controller 36 to set the  
15 time/channel programming 40. Built into the VCR is a  
clock 42. This is normally provided in a VCR and is used  
to keep track of the date and time. The clock 42 is used  
primarily by the time/channel programming 40 and the  
G-code decoder 38 functions. The time/channel programming  
20 40 function is set up with CDTL information by the command  
controller 36. When the proper date and time is read from  
clock 42, then the time/channel programming 40 function  
turns the record/playback 44 function "ON" to record. At  
the same time the tuner 46 is tuned to the proper channel  
25 in the television signal 18. Later the user can command  
the record/playback 44 function to a playback mode to  
watch the program via the television monitor 48.

An alternate way to control the recorder is to have  
the command controller 36 keep all the CDTL information  
30 instead of sending it to the time/channel programming 40.  
The command controller would also keep track of the time  
by periodically reading clock 42. The command controller  
would then send commands to the time/channel programming  
40 to turn on and off the recorder and to tuner 46 to  
35 cause it to tune to the right channel at the right time  
according to the CDTL information.

1       The clock 42 is also an input to G-code decoder 38,  
which allows the G-code decoding to be a function of the  
clock, which lends a measure of security to the decoding  
technique and makes it harder to copy. Of course this  
5       requires that the encoding technique must also be a  
function of the clock.

A possible realization of the command controller 36  
and the G-code decoder 38 is shown in FIG. 2. The command  
controller 36 function can be realized with a  
10       microprocessor 50, a random access memory 52 and a read  
only memory 54, which is used for program storage. The  
input/output 56 function is adapted to receive commands  
from the command signal receiver 30, the manual controls  
34 and the clock 42, and to output signals to a display  
15       35, the clock 42, and the time/channel programming 40  
function. If the microprocessor 50 interprets that a  
G-code has been received, then the G-code is sent to  
microcontroller 60 for decoding. The microcontroller 60  
has an embedded random access memory 62 and an embedded  
20       read only memory 64 for program and table storage. The  
clock 42 can be read by both microprocessor 50 and  
microcontroller 60.

An alternative to having microcontroller 60 perform  
the G-code decoding is to build the G-code decoding  
25       directly into the program stored in read only memory 54.  
This would eliminate the need for microcontroller 60. Of  
course, other hardware to perform the G-code decoding can  
also be used. The choice of which implementation to use  
is primarily an economic one.

30       The blocks in Figs. 1 and 2 are well known in the  
prior art and are present in the following patents:  
Fields, patent no. 4,481,412; Scholz, patent no.  
4,519,003; and Brugliera, patent no. 4,631,601. For  
example, clock 42 is analogous to element 7 in Scholz and  
35       element 17 in Brugliera. Other analogous elements are:  
command signal receiver 30 and Scholz 14 and Brugliera 12;  
tuner 46 and Scholz 6 and Brugliera 10; time/channel



1 programming 40 and Scholz 8, 11 and Brugliera 16; record  
& playback 44 and Scholz 1, 2, 4; command controller 36  
and Scholz 11, 10 and Brugliera 12; microprocessor 50 and  
Fields 27; RAM 52 and Fields 34; ROM 54 and Fields 33;  
5 manual controls 34 and Scholz 15, 16; and remote  
controller 12 and Scholz 26 and Brugliera 18.

FIG. 3 illustrates an alternate preferred embodiment  
of this invention. In FIG. 3 a remote controller with  
embedded G-code decoder 80 is provided. The remote  
10 controller with embedded G-code decoder 80 is very similar  
to remote controller 12, except for the addition of the  
G-code decoder 82. Note that it is also possible in any  
remote controller to provide a display 84. The remote  
controller with embedded G-code decoder 80 would be used  
15 in conjunction with a normal video cassette  
recorder/player 70, which would not be required to have an  
embedded G-code decoder. The numerals for the subelements  
of video cassette recorder/player 70 are the same as  
described above for the video cassette recorder/player  
20 with G-code decoder 14 and have the same function, except  
for the absence of G-code decoder 38. This preferred  
embodiment has the advantage that it can be used in  
conjunction with VCRs that are presently being used.  
These do not have a G-code decoding capability. Replacing  
25 their remote controllers with ones that have this  
capability built-in can vastly improve the capability to  
do timer preprogramming for a modest cost.

FIG. 4 illustrates a possible realization of the  
G-code decoder 82 built into the remote controller with  
30 embedded G-code decoder 80. A microcontroller 60 can be  
used as before to decode the G-code, as well as interface  
with the display 84, a clock 85, the keypad 88 and the  
light emitting diode 28. Alternately, other hardware  
implementations can be used to perform the G-code  
35 decoding. The clock 85 is provided in the remote  
controller 80 so that the G-code decoder 82 can be made to  
have the clock 85 as one of its inputs. This allows the

1 G-code decoding to be a function of the clock 85, which  
lends a measure of security to the decoding technique and  
makes it harder to copy.

5 The remote controller with embedded G-code decoder as  
described above would send channel, date, time and length  
information to the video cassette recorder/player 70,  
which would use the CDTL information for tuning into the  
correct channel and starting and stopping the recording  
function. The remote controller may have to be unique for  
10 each different video cassette recorder/player, because  
each brand or model may have different infrared pulses for  
each type of information sent such as the channel number  
keys and start record and stop record keys. The  
particular infrared pulses used for each key type can be  
15 called the vocabulary of the particular remote controller.  
Each model may also have a different protocol or order of  
keys that need to be pushed to accomplish a function such  
as timer preprogramming. The protocol or order of keys to  
accomplish a function can be called sentence structure.  
20 If there is a unique remote controller built for each  
model type, then the proper vocabulary and sentence  
structure can be built directly into the remote  
controller.

25 An alternate to having the remote controller with  
embedded G-code decoder send channel, date, time and  
length information to the video cassette recorder/player  
70, is to have the remote controller with embedded G-code  
decoder perform more operations to simplify the  
interfacing problem with existing video cassette  
30 recorder/players. In particular, if the remote  
controller not only performs the G-code decoding to CDTL,  
but also keeps track of time via clock 85, then it is  
possible for the remote controller to send just channel,  
start record and stop commands to the video cassette  
35 recorder/player. The channel, start and stop are usually  
basic one or two key commands, which means there is no  
complicated protocol or sentence structure involved.

1 Thus, to communicate with a diverse set of video cassette  
recorder/player models it is only necessary to have memory  
within the remote controller, such as ROM 64 of FIG. 4,  
for storing the protocol for all the models or at least a  
5 large subset. The G-code would be entered on the remote  
controller as before and decoded into channel, date, time  
and length information, which would be stored in the  
remote controller. Via clock 85, the time would be  
checked and when the correct time arrives the remote  
10 controller would automatically send out commands to the  
VCR unit for tuning to the correct channel and for  
starting and stopping the recording. It is estimated that  
only two (2) bytes per key for about 15 keys need to be  
stored for the vocabulary for each video cassette  
15 recorder/player model. Thus, to cover 50 models would  
only require about  $30 \times 50 = 1500$  bytes of memory in the  
remote controller. It would be necessary to position the  
remote controller properly with respect to the VCR unit so  
that the infrared signals sent by the remote controller  
20 are received by the unit.

Another preferred embodiment is to provide a  
universal remote controller 90 with an embedded G-code  
decoder. Universal remote controllers provide the  
capability to mimic a number of different remote  
25 controllers. This reduces the number of remote  
controllers that a user needs to have. This is  
accomplished by having a learn function key 94 function on  
the universal remote controller, as shown in FIG. 5. If  
the learn function key 94 is pushed in conjunction with  
30 another key, the unit will enter into the learn mode.  
Incoming infra-red (IR) pulses from the remote controller  
to be learned are detected by the infra-red photodiode 96,  
filtered and wave-shaped into recognizable bit patterns  
before being recorded by a microcontroller into a  
35 battery-backed static RAM as the particular IR pulse  
pattern for that particular key. This is done for all the  
individual keys.

1       An example of more complex learning is the following.  
If the learn function key 94 in conjunction with the  
program key 26 are pushed when the G-code switch is "ON",  
the unit will recognize that it is about to record the  
5       keying sequence of a predetermined specific example of  
timer preprogramming of the particular VCR involved. The  
user will then enter the keying sequence from which the  
universal remote controller 90 can then deduce and record  
the protocol of the timer preprogramming sequence. This  
10       is necessary because different VCRs may have different  
timer preprogramming command formats.

If keys are pushed without the learn function key 94  
involved, the microcontroller should recognize it is now  
in the execute mode. If the key is one of the direct  
15       command keys, the microcontroller will read back from its  
static RAM the stored pulse sequence and send out command  
words through the output parallel I/O to pulse the output  
light emitting diode 28. If the key is the PROG key and  
the G-code switch is "OFF", then the microcontroller  
20       should recognize the following keys up to the next PROG  
key as a timer preprogramming CDTL command and send it out  
through the light emitting diode 28. If the G-code switch  
22 is set to "ON" and the program key 26 is pushed, the  
microcontroller should recognize the following keys up to  
25       the next PROG key as a G-code command for timer  
preprogramming. It will decode the G-code into channel,  
date, start time and length (CDTL) and the microcontroller  
will then look up in its static RAM "dictionary" the  
30       associated infra-red pulse patterns and concatenate them  
together before sending them off through the output  
parallel I/O to pulse the light emitting diode 28 to send  
the whole message in one continuous stream to the VCR.

FIG. 4 illustrates a possible realization of the  
G-code decoder 92 that could be built into the universal  
remote controller with embedded G-code decoder 90. A  
35       microcontroller 60 can be used as before to decode the  
G-code, as well as for interfacing with the input/output

1 functions including the photodiode 96. Alternately, the  
G-code decoding can be performed with other hardware  
implementations.

5 The universal remote controller can also be used in  
another manner to simplify the interfacing problem with  
existing video cassette recorder/players. In particular,  
if the universal remote controller performs not only the  
G-code decoding to CDTL, but also keeps track of time via  
10 clock 85 in FIG. 4, then it is possible for the universal  
remote controller to send just channel, start record and  
stop commands to the video cassette recorder/player, which  
as explained before, are usually basic one key commands,  
which means there is no complicated protocol or sentence  
15 structure involved. Thus, to communicate with a diverse  
set of video cassette recorder/player models it is only  
necessary for the universal remote controller to "learn"  
each key of the remote controller it is replacing. The  
G-code would be entered on the universal remote controller  
as before and decoded into channel, date, time and length  
20 information, which would be stored in the universal remote  
controller. Via clock 85, the time would be checked and  
when the correct time arrives the universal remote  
controller would automatically send out commands to the  
VCR unit for tuning to the correct channel and for  
25 starting and stopping the recording. It would be  
necessary to position the universal remote controller  
properly with respect to the VCR unit so that the signals  
sent by the universal remote are received by the VCR unit.

30 There are a number of ways that the G-code decoding  
can be performed. The most obvious way is to just have a  
large look up table. The G-code would be the index.  
Unfortunately, this would be very inefficient and result  
in a very expensive decoder due to the memory involved.  
The total storage involved is a function of the number of  
35 total combinations. If we allow for 128 channels, 31 days  
in a month, 48 on the hour and on the half hour start  
times in a twenty four hour day, and 16 length selections

1 in half hour increments, then the total number of  
combinations is  $128 \times 31 \times 48 \times 16 = 3,047,424$ . This number of  
combinations can be represented by a 7 digit number. The  
address to the table would be the 7 digit number. In the  
5 worst case, this requires a look up table that has about  
4,000,000 rows by 15 to 16 digital columns, depending on  
the particular protocol. These digital columns would  
correspond to the CDTL information required for "on screen  
programming". Each digit could be represented by a 4 bit  
10 binary number. Thus, the total storage number of bits  
required for the look up table would be about  
 $4,000,000 \times 16 \times 4 = 256,000,000$ . The present state of the  
art has about 1 million bits per chip. Thus, G-code  
decoding using a straightforward table look up would  
15 require a prohibitively expensive number of chips.

Fortunately, there are much more clever ways of  
performing the G-code decoding. FIG. 6 is a flow diagram  
of a preferred G-code decoding technique. To understand  
G-code decoding, it is easiest to first explain the G-code  
20 encoding technique, for which FIG. 7 is the flow chart.  
Then the G-code decoding technique, which is the reverse  
of the G-code encoding will be explained.

The encoding of the G-codes can be done on any  
computer and is done prior to preparation of any program  
25 guide that would include G-codes. For each program that  
will be printed in the guide, a channel, date, time and  
length (CDTL) code 144 is entered in step 142. Step 146  
separately reads the priority for the channel, date, time  
and length in the priority vector storage 122, which can  
30 be stored in read only memory 64. The priority vector  
storage 122 contains four tables: a priority vector C  
table 124, a priority vector D table 126, a priority  
vector T table 128 and a priority vector L table 130.

The channel priority table is ordered so that the  
35 most frequently used channels have a low priority number.

1 An example of the data that is in priority vector C table  
124 follows.

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

5 Generally the dates of a month all have an equal  
priority, so the low number days in a month and the low  
number priorities would correspond in the priority vector  
D table as in the following example.

10

date	1	2	3	4	5	6	7	8	...
priority	0	1	2	3	4	5	6	7	...

15 The priority of the start times would be arranged so  
that prime time would have a low priority number and  
programs in the dead of the night would have a high  
priority number. For example, the priority vector T table  
would contain:

20

time	6:30pm	7:00pm	8:00pm	7:30pm	...
priority	0	1	2	3	...

An example of the data that is in the priority vector  
L table 130 is the following:

25

length of program (hours)	0.5	1.0	2.0	1.5	3.0	...
priority	0	1	2	3	4	...

30 Suppose the channel date time length (CDTL) 144 data  
is 5 10 19.00 1.5, which means channel 5, 10th day of the  
month, 7:00 PM, and 1.5 hours in length, then for the  
above example the C<sub>p</sub>, D<sub>p</sub>, T<sub>p</sub>, L<sub>p</sub> data 148, which are the result  
of looking up the priorities for channel, date, time and  
length in priority tables 124, 126, 128 and 130 of FIG. 7,  
35 would be 4 9 1 3. Step 150 converts C<sub>p</sub>, D<sub>p</sub>, T<sub>p</sub>, L<sub>p</sub> data to  
binary numbers. The number of binary bits in each

1 conversion is determined by the number of combinations  
involved. Seven bits for  $C_p$ , which can be denoted as  $C_7$ ,  
 $C_6, C_5, C_4, C_3, C_2, C_1$ , would provide for 128 channels. Five bits  
for  $D_p$ , which can be denoted as  $D_5, D_4, D_3, D_2, D_1$ , would  
5 provide for 31 days in a month. Six bits for  $T_p$ , which  
can be denoted as  $T_6, T_5, T_4, T_3, T_2, T_1$ , would provide for 48  
start times on each half hour of a twenty four hour day.  
Four bits for length, which can be denoted as  $L_4, L_3, L_2, L_1$ ,  
would provide for a program length of up to 8 hours in  
10 half hour steps. Together there are  $7+5+6+4 = 22$  bits of  
information, which correspond to  $2^{**22} = 4,194,304$  combinations.

The next step is to use bit hierarchy key 120, which  
can be stored in read only memory 64 to reorder the 22  
15 bits. The bit hierarchy key 120 can be any ordering of  
the 22 bits. For example, the bit hierarchy key might be:

$L_1$	$C_1$	...	$T_1$	$C_2$	$T_1$	$C_1$	$L_1$	$D_5$	$D_4$	$D_3$	$D_2$	$D_1$
22	21	...	10	9	8	7	6	5	4	3	2	1

20

Ideally the bit hierarchy key is ordered so that  
programs most likely to be the subject of timer  
preprogramming would have a low value binary number, which  
would eliminate keystrokes for timer preprogramming the  
25 most popular programs. Since all the date information has  
equal priority, then the  $D_5, D_4, D_3, D_2, D_1$  bits are first.  
Next  $T_1, C_1, L_1$  are used, because for whatever date it is  
necessary to have a time channel and length and  $T_1, C_1, L_1$   
are the most probable in each case due to the ordering of  
30 the priority vectors in priority vector storage 122. The  
next bit in the hierarchy key is determined by the  
differential probabilities of the various combinations.  
One must know the probabilities of all the channels, times  
and lengths for this calculation to be performed.  
35



1 For example, the probability for channels may be:

	channel	4	7	2	3	5	6	11	13	...
	priority	0	1	2	3	4	5	6	7	...
5	probability(%)	5	4.3	4	3	2.9	2.1	2	1.8	...

The probabilities for times might be:

	time	6:30pm	7:00pm	8:00pm	7:30pm	...
10	priority	0	1	2	3	...
	probability(%)	8	7.8	6	5	...

And, the probabilities for lengths might be:

15	length of program (hours)	0.5	1.0	2.0	1.5	3.0	...
	priority	0	1	2	3	4	...
	probability(%)	50	20	15	5	4	...

20 The probabilities associated with each channel, time and length, as illustrated above, are used to determine the proper ordering. Since the priority vector tables are already ordered by the most popular channel, time, and length, the order in which to select between the various binary bits for one table, for example selecting between

25 the  $C_1, C_4, C_3, C_2, C_1$  bits, is already known. The  $C_1$  bit would be selected first because as the lowest order binary bit it would select between the first two entries in the channel priority table. Then the  $C_2$  bit would be selected and so on. Similarly, the  $T_1$  and  $L_1$  bits would be used

30 before any of the other time and length bits. A combination of the  $C_1, T_1, L_1$  and  $D_1, D_4, D_3, D_2, D_1$  bits should be used first, so that all the information is available for a channel, date, time and length. The  $D_1, D_4, D_3, D_2, D_1$  bits are all used because the date bits all have equal

35 priority and all are needed to specify a date even if some of the bits are binary zero.

1 At this point the bit hierarchy key could be:

$T_1, C_1, L_1, D_1, D_4, D_3, D_2, D_1$

5 The first channel binary bit  $C_1$  by itself can only select between  $2^1 = 2$  channels, and the first two channels have a probability percent of 5 and 4.3, respectively. So the differential probability of  $C_1$  is 9.3. Similarly, the differential probability of  $T_1$  is  $8 + 7.8 = 15.8$ , and the differential probability of  $L_1$  is  $50 + 20 = 70$ . If the rules for ordering the bit hierarchy key are strictly followed, then the first 8 bits of the bit hierarchy key should be ordered as:

15  $C_1, T_1, L_1, D_1, D_4, D_3, D_2, D_1,$

because  $L_1$  has the highest differential priority so it should be next most significant bit after  $D_1$ , followed by  $T_1$  as the next most significant bit, and then  $C_1$  as the next most significant bit. Notice that the bit hierarchy key starts with the least significant bit  $D_1$ , and then is filled in with the highest differential probability bits. This is for the purpose of constructing the most compact codes for popular programs.

25 The question at this point in the encoding process is what should the next most significant bit in the hierarchy key be:  $T_1$ ,  $C_1$ , or  $L_1$ . This is again determined by the differential probabilities, which can be calculated from the above tables for each bit. Since we are dealing with binary bits, the  $C_1$  in combination with  $C_1$  selects between  $2^2 = 4$  channels or 2 more channels over  $C_1$  alone. The differential probability for  $C_1$  is then the additional probabilities of these two additional channels and for the example this is:  $4 + 3 = 7$ . In a similar manner  $C_1$  in combination with  $C_1$  and  $C_1$  selects between  $2^3 = 8$  channels or  $4 = 2^{(2-1)}$  more channels over the combination of  $C_1$  and  $C_1$ .

1 So the differential probability of  $C_1$  is the additional  
probabilities of these four additional channels and for  
the example this is:  $2.9 + 2.1 + 2 + 1.8 = 8.8$ . In a  
similar manner, the differential probabilities of  $T_1$  and  
5  $L_1$  can be calculated to be  $6 + 5 = 11$  and  $15 + 5 = 20$ ,  
respectively. Once all the differential probabilities are  
calculated, the next step is determining which  
combinations of bits are more probable.

Now for the above example, which combination is more  
10 probable:  $T_1$  with  $C_1$ ,  $L_1$ , or  $C_2$  with  $T_1$ ,  $L_1$ , or  $L_2$  with  $T_1$ ,  $C_1$ .  
This will determine the next bit in the key. So, which is  
greater:  $11 \times 9.3 \times 70 = 7161$ ;  $7 \times 15.8 \times 70 = 7742$ ; or  $20 \times 15.8 \times 9.3 =$   
 $2938.8$ ? In this case the combination with the greatest  
probability is  $7 \times 15.8 \times 70 = 7742$ , which corresponds to  $C_2$   
15 with  $T_1$ ,  $L_1$ . So,  $C_2$  is selected as the next bit in the bit  
hierarchy key.

The next bit is selected in the same way. Which  
combination is more probable:  $C_3$  with  $T_1$ ,  $L_1$ , or  $T_2$  with  $C_1$ ,  
or  $C_2$  and  $L_1$ , or  $L_2$  with  $C_1$  or  $C_2$  and  $T_1$ . For the example  
20 shown, which has the greatest probability:  $8.8 \times 15.8 \times 70 =$   
 $9732.8$ ;  $11 \times (9.3 + 7) \times 70 = 12551$ ; or  $20 \times (9.3 + 7) \times 15.8 = 5150.8$ ?  
In this case the combination with the greatest probability  
is  $11 \times (9.3 + 7) \times 70 = 12551$ , which corresponds  $T_2$  with  $C_1$  or  $C_2$   
and  $L_1$ . So,  $T_2$  is selected as the next bit in the bit  
25 hierarchy key. This procedure is repeated for all the  
differential probabilities until the entire key is found.

Alternately, the bit hierarchy key can be just some  
arbitrary sequence of the bits. It is also possible to  
make the priority vectors interdependent, such as making  
30 the length priority vector dependent on different groups  
of channels. Another technique is to make the bit  
hierarchy key 120 and the priority vector tables 122, a  
function of clock 42, as shown in FIG. 7. This makes it  
very difficult for the key and therefore the coding  
35 technique to be duplicated or copied.

1 For example it is possible to scramble the date bits  
in the bit hierarchy key 120 as a function of the clock.  
Changing the order of the bits as a function of the clock  
would not change the effectiveness of the bit hierarchy  
5 key in reducing the number of binary bits for the most  
popular programs, because the date bits all are of equal  
priority. This could be as simple as switching the  $D_1$  and  
 $D_3$  bits periodically, such as every day or week. Thus  
the bit hierarchy key 120 would switch between

10

...  $C_1 T_1 L_1 D_3 D_4 D_3 D_2 D_1$  and

...  $C_1 T_1 L_1 D_1 D_4 D_3 D_2 D_3$ .

15 Clearly other permutations of the bit hierarchy key as a  
function of the clock are possible.

The priority vector tables could also be scrambled as  
a function of the clock. For example, the first two  
channels in the priority channel table could just be  
20 swapped periodically. If this technique is followed, then  
the  $C_p$  of 148 in FIG. 7 would change as a function of the  
clock 42. For example,

25

channel	4	7	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

would change periodically to:

30

channel	7	4	2	3	5	6	11	13	...
priority	0	1	2	3	4	5	6	7	...

35 This would be a fairly subtle security technique,  
because a decoder that was otherwise correct would only  
fail if those first two channels were being used. Other  
clock dependencies are also possible to provide security  
for the coding technique.

1        However it is derived, the bit hierarchy key 120 is  
determined and stored. In step 154 the binary bits of  
C<sub>p</sub>, D<sub>p</sub>, T<sub>p</sub>, L<sub>p</sub> are rearranged according to the bit hierarchy  
key 120 to create one 22 bit binary number. Then the  
5        resulting 22 bit binary number is converted to decimal in  
the convert binary number to decimal G-code step 156. The  
result is G-code 158.

10       If the priority vector and the bit hierarchy key are  
well matched to the viewing habits of the general  
population, then it is expected that the more popular  
programs would require no more than 3 or 4 digits for the  
G-code.

15       Now that the encoding technique has been explained  
the decoding technique is just reversing the coding  
technique. This is done according to the flow chart of  
FIG. 6. This is the preferred G-code decoding that can be  
built into G-code decoder 38 in VCR 14 or the remote  
controller G-code decoders 82 and 92 in FIGs. 3 and 5.

20       The first step 102 is to enter G-code 104. Next the  
G-code 104 is converted to a 22 bit binary number in step  
106. Then the bits are reordered in step 108 according to  
the bit hierarchy key 120 to obtain the reordered bits  
110. Then the bits are grouped together and converted to  
decimal form in step 112. As this point we obtain  
25       C<sub>p</sub>, D<sub>p</sub>, T<sub>p</sub>, L<sub>p</sub> data 114, which are the indices to the priority  
vector tables. For the above example, we would have at  
this step the vector 4 9 1 3. This C<sub>p</sub>, D<sub>p</sub>, T<sub>p</sub>, L<sub>p</sub> data 114 is  
then used in step 116 to look up channel, date, time, and  
length in priority vector storage 122. The CDTL 118 for  
30       the example above is 5 10 19.00 1.5, which means channel  
5, 10th day of the month, 7:00 PM, and 1.5 hours in  
length.

35       If the coding technique is a function of the clock  
then it is also necessary to make the decoding technique  
a function of the clock. It is possible to make the bit  
hierarchy key 120 and the priority vector tables 122, a

1 function of clock 42, as shown in FIG. 6. This again  
makes it very difficult for the key and therefore the  
coding technique to be duplicated or copied. It is also  
possible to have the decoding and encoding techniques  
5 dependent on any other predetermined or preprogrammable  
algorithm.

Although the above G-code encoding and decoding  
technique is a preferred embodiment, it should be  
understood that there are many ways to perform the intent  
10 of the invention which is to reduce the number of  
keystrokes required for timer preprogramming. To  
accomplish this goal there are many ways to perform the  
G-code encoding and decoding. There are also many ways to  
make the encoding and decoding technique more secure  
15 besides just making the encoding and decoding a function  
of the clock. This security can be the result of any  
predetermined or preprogrammed algorithm.

It is possible in the G-code coding and decoding  
techniques to use mixed radix number systems instead of  
20 binary numbers. For example, suppose that there are only  
35 channels, which would require 6 binary bits to be  
represented; however, 6 binary bits can represent 64  
channels, because  $2^6 = 64$ . The result is that in a binary  
number system there are 29 unnecessary positions. This  
25 can have the effect of possibly making a particular G-code  
longer than it really needs to be. A mixed radix number  
system can avoid this result. For example, for the case  
of 35 channels, a mixed radix number system with the  
factors of  $7^1$  and  $5^0$  can represent 35 combinations without  
30 any empty space in the code. The allowed numbers for the  
 $7^1$  factor are 0, 1, 2, 3, and 4. The allowed numbers for  
the  $5^0$  factor are 0, 1, 2, 3, 4, 5, and 6. For example,  
digital 0 is represented in the mixed radix number system  
as 00. The digital number 34 is represented in the mixed  
35 radix number system as 46, because  $4*7^1 + 6*5^0 = 34$ . The  
major advantage of a mixed radix number system is in

1 prioritizing the hierarchy key. If the first 5 channels  
have about equal priority and the next 30 are also about  
equal, then the mixed radix number system allows the two  
tiers to be accurately represented. This is not to say  
5 that a mixed radix number system is necessarily  
preferable. Binary numbers are easier to represent in a  
computer and use of a fixed radix number system such as  
binary numbers allows a pyramid of prioritization to be  
easily represented in the hierarchy key.

10 Another feature that is desirable in all of the  
embodiments is the capability to key in the G-code once  
for a program and then have the resulting CDTL information  
used daily or weekly. Ordinarily the CDTL information is  
discarded once it is used. In the case of daily or weekly  
15 recording of the same program, the CDTL information is  
stored and used until it is cancelled. The desire to  
repeat the program daily or weekly can be performed by  
having a "WEEKLY" or "DAILY" button on the remote  
controller or built into the VCR manual controls. Another  
20 way is to use one key, such as the PROG key and push it  
multiple times within a certain period of time such as  
twice to specify daily or thrice to specify weekly. For  
example, if the G-code switch is "ON" and the G-code for  
the desired program is 99 then daily recording of the  
25 program can be selected by the following keystrokes:

"PROG 99 DAILY PROG"

or by:

"PROG 99 PROG PROG".

The G-code 99 would be converted to CDTL information,  
which would be stored and used daily in this case. The  
30 recording would begin on the date specified and continue  
daily after that using the same channel time and length  
information. A slight twist is that daily recording could  
be automatically suspended during the weekends, because  
35 most daily programs are different on Saturday and Sunday.

Once a daily or weekly program is set up, then it can  
be used indefinitely. If it is desired to cancel a

1 program and if there is a "CANCEL" button on the remote  
controller or manual control for the VCR, then one way to  
cancel a program (whether it is a normal CDTL, daily or  
weekly entry) is to key in the following:

5 "PROG xx CANCEL", where xx is the G-code.  
Again as before there are alternate ways of accomplishing  
this.

If "on screen programming" is available, then the  
programs that have been selected for timer preprogramming  
10 could be reviewed on the screen. The daily and weekly  
programs would have an indication of their type. Also the  
G-codes could be displayed along with the corresponding  
CDTL information. This would make it quite easy to review  
the current "menu" and either add more programs or cancel  
15 programs as desired.

A television calendar 200 according to this invention  
is illustrated in FIG. 8. As shown, the television  
calendar has multiple day of year sections 202, multiple  
day sections 204, multiple time of day sections 206,  
20 channel identifiers 208, and descriptive program  
identifiers 210, including the name of the program,  
arranged in a manner that is common in television guide  
publications. Arranged in relation to each channel  
identifier is a compressed code indication 212 or G-code  
25 containing the channel, date, time and length information  
for that entry in the television calendar. FIG. 8 shows  
how easy it is to perform timer programming. All one  
needs to do is find the program one wants to watch and  
enter the compressed code shown in the compressed code  
30 indication. This is in contrast to having to deal with  
all the channel, date, time and length entries separately.  
At least the channel, date and time are explicitly stated  
in the television guide. The length is usually only  
available by searching the guide to find the time of day  
35 section 206 where a new program begins and then performing  
some arithmetic to find the length of the program. Using  
the compressed G-code avoids all these complications.



1       For cable television programs, there is an additional  
issue that needs to be addressed for the compressed G-code  
to be useful. In a normal television guide, CDTL  
information is available for all the normal broadcast  
5 channels in the form of numbers including the channel  
numbers, such as channel 4 or 7. However, for cable  
channels like HBO, ESPN etc., only the names of the  
channels are provided in most television listings. The  
reason for this is that in some metropolitan areas, such  
10 as Los Angeles, there may be only one (1) edition of  
television guide, but there may be quite a few cable  
carriers, each of which may assign HBO or ESPN to  
different cable channel numbers. In order for a  
compressed code such as the G-code to be applicable to the  
15 cable channels as published by a wide area television  
guide publication, the following approach can be used.

First, all the cable channels would be permanently  
assigned a unique number, which would be valid across the  
nation. For example, we could assign ESPN to cable  
20 channel 1, HBO as cable channel 2, SHO as cable channel 3,  
etc. This assignment would be published by the television  
guide publications.

The video cassette recorder apparatus, such as the  
remote controller, the VCR unit or both, could then be  
25 provided with two (2) extra modes: "set" and "cable  
channel". One way of providing the user interface to  
these modes would be to provide two (2) extra buttons: one  
called SET and one called CABLE CHANNEL. The button  
could be located on the video cassette recorder unit  
30 itself or located on a remote controller, as shown in FIGS  
1, 3 and 5, where SET is element 168 and CABLE CHANNEL is  
element 170. Of course, other user interfaces are  
possible.

Next, the television viewer would have to go through  
35 a one-time "setting" procedure of his VCR for all the  
cable channels that he would likely watch. This "setting"  
procedure would relate each of the assigned numbers for

1 each cable channel to the channel number of the local  
cable carrier. For example, suppose that the local cable  
carrier uses channel 6 for ESPN, then cable channel  
number 1 could be assigned to ESPN, as shown in the  
5 following table.

	<u>Cable Channel</u>	<u>Assigned</u>	<u>Channel Number in</u>
	<u>Name</u>	<u>Cable Chan. No.</u>	<u>the local cable carrier</u>
	ESPN	1	6
10	HBO	2	24
	SHO	3	23
	.	.	.
	.	.	.
	.	.	.
15	DIS	8	25

The user could perform the "setting" procedure by pushing  
the buttons on his remote controller as follows:

20 SET 06 CABLE CHANNEL 1 PROGRAM  
SET 24 CABLE CHANNEL 2 PROGRAM  
SET 23 CABLE CHANNEL 3 PROGRAM  
SET 25 CABLE CHANNEL 8 PROGRAM

25 The "setting" procedure would create a cable channel  
address table 162, which would be loaded into RAM 52 of  
command controller 36. For the above example, the cable

30

35

1 channel address table 162 would have the following  
information.

5

<u>CABLE CHANNEL ADDRESS TABLE 162</u>	
1	6
2	24
3	23
.	
.	
.	
8	25

10

After the "setting" procedure is performed, the TV  
viewer can now select cable channels for viewing by the  
old way: eg. pushing the key pad buttons 24 will select  
HBO. He can also do it the new way: eg. by pushing CABLE  
CHANNEL 2, which will also select HBO. The advantage of  
the new way is that the television guide will publish [C2]  
next to the program description, so the viewer will just  
look up the assigned channel number identifier instead of  
having to remember that HBO is local cable channel 24.  
When the CABLE CHANNEL button is pushed, command  
controller 36 knows that it will look up the local cable  
channel number in cable channel address table 162 to tune  
the VCR to the correct channel.

For timer preprogramming and for using the compressed  
G-code, a way to differentiate between broadcast and cable  
channels is to add an eighth channel bit, which would be  
set to 0 for normal broadcast channels and 1 for cable  
channels such as HBO. This eighth channel bit could be  
one of the low order bits such as the third bit C<sub>3</sub> out of  
the eight channel bits, so that the number of bits to  
specify popular channels is minimized, whether they be  
normal broadcast or cable channels. For a normal  
broadcast channel, the 7 other bits can be decoded  
according to priority vector C table 124. For a cable

1 channel, the 7 other bits can be decoded according to a  
separate cable channel priority vector table 160, which  
could be stored in ROM 54 of microcontroller 36. The  
cable channel priority vector table can be set ahead of  
5 time for the entire country or at least for an area  
covered by a particular wide area television guide  
publication.

A television guide that carries the compressed code  
known as the G-code will now print the cable channel  
10 information as follows:

```
6:30 pm
[C2] HBO xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (4679)
      xxxxxx(program description)xxxxxxxxxxx
15      xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

The [C2] in front of HBO reminds the viewer that he needs  
only to push CABLE CHANNEL 2 to select HBO. The (4679) is  
the G-code indication for this particular program.

20 FIG. 8 shows a section of a television guide. The  
cable channels all have an assigned cable channel number  
188 in front of the cable channel mnemonic. Other than  
that the cable channel information is arranged the same as  
the broadcast channels with a compressed G-code 212  
25 associated with the channel.

For timer preprogramming, the viewer need only enter  
the number 4679 according to the unit's G-code entry  
procedure, eg. PROG 4679 PROG. The G-code decoder unit  
will decode this G-code into "cable channel 2" and will  
30 also signal the command controller 36 with a cable channel  
signal 164, as shown in FIGs. 1 and 2, because the extra  
channel bit will be "1" which distinguishes that the  
G-code is for a cable channel; then, since the association  
of "cable channel 2" with channel 24 has been established  
35 earlier in the "setting" procedure, the command  
controller, if it has received a cable channel signal,  
will immediately look up 2 in the cable channel address

1 table 162 to translate it to cable channel 24, which will  
be used as the recording channel at the appropriate time.  
By associating the G-code with the assigned cable channel  
number rather than the local cable channel number, the  
5 G-code for that program will be valid in the whole local  
area, which may have many different cable carriers each of  
which may have different local cable channel numbers.

To include the cable channel compressed G-code  
feature, the decoding and encoding algorithms are as shown  
10 in FIGs 9 and 10, respectively. The encoding should be  
explained first before the decoding. The primary change  
in FIG. 10 from FIG. 7 is that a cable channel priority  
vector table 160 has been added and is used in look up  
priority step 180 if a cable channel is being encoded.  
15 Also if a cable channel is being encoded then the cable  
channel bit is added in the correct bit position in the  
convert  $C, D, T, L$ , to binary numbers step 182. This could be  
bit  $C_1$ , as discussed before. The bit hierarchy key could  
be determined as before to compress the number of bits in  
20 the most popular programs; however, it needs to be 23 bits  
long to accommodate the cable channel bit. The maximum  
compressed G-code length could still be 7 digits, because  
 $2^3 = 8,388,608$ .

The decoding is shown in FIG. 9 and is just the  
25 reverse of the encoding process. After step 108, test  
cable channel bit 174 is added and effectively tests the  
cable channel bit to determine if it is a "1". If so then  
the command controller 36 is signaled via cable channel  
signal 164 of FIGs. 1 and 2 that the CDTL 118 that will be  
30 sent to it from G-code decoder 38 is for a cable channel.  
Then the command controller knows to look up the local  
cable carrier channel number based on the assigned cable  
channel number. In step 176 of FIG. 9, the priority  
vector tables including the cable channel priority vector  
35 table 160 are used to look up the CDTL 118 information.

1       An alternate to having the command controller receive  
a cable channel signal 164 is for the G-code decoder to  
perform all of the decoding including the conversion from  
assigned cable channel number to local cable carrier  
5       number. This would be the case for the remote controller  
implementation of FIG. 3. FIG. 11 shows the  
implementation of the entire decode algorithm if this step  
is included. All that needs to be added is convert  
assigned channel to local cable carrier channel step 166,  
10       which performs a look up in cable channel address table  
162, if the cable channel bit indicates that a cable  
channel is involved. Step 166 effectively replaces step  
174 in FIG. 9.

Another issue that needs addressing is the number of  
15       programs that can be preprogrammed. Since the G-code  
greatly simplifies the process of entering programs, it is  
likely that the user will quickly learn and want to enter  
a large number of programs; however, some existing VCRs  
can only store up to four (4) programs, while some can  
20       store as many as eight. Thus, the user may get easily  
frustrated by the programming limitations of the VCR.

One approach to this problem, is to perform the  
compressed G-code decoding in the remote controller and  
provide enough memory there to store a large number of  
25       programs, eg. 20 or 40. The remote controller would have  
the capability of transferring periodically several of  
these stored programs at a time to the VCR main unit. To  
provide this capability, extra memory called stack memory  
76 is required inside the remote unit, as shown in FIG.  
30       12, which other than that is identical to FIG. 4. Stack  
memory 76 can be implemented with a random access memory,  
which may in fact reside in the microcontroller itself,  
such as RAM 62.

The stack memory 76 is where new entry, insertion &  
35       deletion of timer preprogramming information is carried  
out. It is also where editing takes place. The top  
memory locations of the stack, for example the first 4

1 locations, correspond exactly to the available timer  
preprogramming memory in the VCR main unit. Whenever the  
top of the stack memory is changed, the new information  
will be sent over to the VCR main unit to update it.

5 FIG. 13 shows the sequence of events when the user  
enters a G-code program on the keypad of the remote  
controller. For illustration purposes, suppose the VCR  
main unit can only handle four (4) programs. Suppose also  
that the stack memory capacity is 20 timer preprograms.  
10 Referring to the flow chart in FIG.13, when the user  
enters a G-code in step 230, the microcontroller 60 first  
decodes it into the CDTL information in step 234 and  
displays it on the display unit with the additional word  
"entered" also displayed. The microcontroller then enters  
15 the decoded program into the stack memory in step 236.

If this is the first program entered, it is placed at  
the top location of the stack memory. If there are  
already programs in the stack memory, the newly entered  
program will first be provisionally placed at the bottom  
20 of the stack memory. The stack memory will then be sorted  
into the correct temporal order in step 240, so that the  
earliest program in time will appear in the top location  
and the last program in time will be at the bottom.  
Notice that the nature of the temporally sorted stack  
25 memory is such that if stack memory location n is altered,  
then all the locations below it will be altered.

For example, suppose the stack memory has six (6)  
entries already temporally ordered, and a new entry is  
30 entered whose temporal ordering places it in location 3 (1  
being the top location). If this entry is placed into  
location 3, information which was in location 3, 4, 5, 6  
will be shifted to locations 4, 5, 6, and 7. Locations 1  
and 2 will remain unchanged.

35 The microcontroller 60, after doing the temporal  
ordering, checks in step 242 whether the first n entries  
have changed from before, where for the current example n  
equals 4. In this case, since a new program has been

1 entered into location 3, what used to be in location 3 now  
moves to location 4. Since the VCR's main unit program  
menu of 4 entries should correspond exactly to location 1  
through 4 of the stack memory, entries 3 and 4 on the VCR  
5 main unit must now be revised. The microcontroller  
therefore sends out the new entries 3 & 4 to the main  
unit, in step 244 of FIG. 13. If the newly entered  
program, after temporal ordering, gets entered into  
location 5, then entries 1 through 4 have not changed from  
10 before and the microcontroller will not send any message  
to the VCR main unit and the microcontroller will just  
resume monitoring the clock 85 and the keyboard 88 as per  
step 246. It is assumed that when the user enters the  
G-code in step 230, the remote controller is pointed at  
15 the VCR main unit. The other steps of FIG. 13 happen so  
fast that the changes are sent in step 244 while the  
remote controller is still being pointed at the VCR main  
unit. If the user decides to delete a program in step  
232, the deletion is first carried out in the stack  
20 memory. If the first 4 entries are affected, the  
microcontroller will send the revised information over to  
the VCR main unit. If the first 4 entries are not  
affected, then again the remote controller unit will not  
send anything. The deletion will only change the lower  
25 part of the stack (lower meaning location 5 to 20). This  
new information will be sent over to the VCR main unit at  
the appropriate time.

In the meantime, the VCR main unit will be carryin  
out its timer programming function, completing its timing  
30 preprogramming entries one by one. By the time all 4  
recording entries have been completed, the stack in the  
remote must send some new entries over to "replenish" the  
VCR main unit (if the stack has more than 4 entries).

The real time clock 85 in the remote controller unit  
35 is monitored by the microcontroller to determine when the  
programs in the main unit have been used up. Referring to  
the flow chart in FIG. 14, the microcontroller



1     periodically checks the clock and the times for the  
programs at the top of the stack in step 250 (say the  
first 4 entries), which are identical to the VCR's main  
unit's menu. If on one of the periodic checks, it is  
5     determined that the recording of the main unit's menu is  
complete, then if there are more entries in the stack,  
which is tested in step 252, the display unit will be set  
to a blinking mode or display a blinking message in step  
258 to alert the user to send more programs. Next time  
10    the user picks up the remote unit, the blinking will  
remind him that the VCR main unit's program menu has been  
completed and it is time to replenish the VCR main unit  
with program entries stored in the remote. The user  
simply picks up the remote and points it towards the VCR  
15    main unit and presses "ENTER". This will "pop" the top of  
the stack memory in step 260, i.e. pop all the entries in  
the stack up by four locations. The microcontroller will  
then send the new "top of the stack" (i.e. top 4 entries)  
over to the VCR main unit in step 262. This process will  
20    repeat until the whole stack has been emptied.

Another preferred embodiment of an apparatus for  
using compressed codes for recorder preprogramming is the  
instant programmer 300 of FIG. 15. The instant programmer  
300 has number keys 302, which are numbered 0 through 9,  
25    a CANCEL key 304, a REVIEW key 306, a WEEKLY key 308, a  
ONCE key 310 and a DAILY (M-F) key 312, which are used to  
program the instant programmer 300. A lid normally  
covers other keys, which are used to setup the instant  
programmer 300. When lid 314 is lifted, the following  
30    keys are revealed: SAVE key 316, ENTER key 318, CLOCK key  
320, CH key 322, ADD TIME key 324, VCR key 326, CABLE key  
328, and TEST key 330. Other features of instant  
programmer 300 shown on FIG. 15 are: liquid crystal  
display 350 and red warning light emitting diode 332. The  
35    front elevation view FIG. 16 of instant programmer 300  
shows front infrared (IR) diode 340 mounted on the front  
side 338. By placing instant programmer 300 in front of

1 the equipment to be programmed such as video cassette  
recorder 370, cable box 372, and television 374, as shown  
in FIG. 19, the front infrared (IR) diode 340 can transmit  
signals to control program recording. An IR transparent  
5 cover 336 covers additional IR transmission diodes, which  
are explained below.

FIG. 18 shows a detail of the liquid crystal display  
350. Certain text 354 is at various times visible on the  
display and there is an entry area 356. Time bars 352 are  
10 displayed at the bottom of the display and their function  
is described below.

A companion element to the instant programmer 300 is  
the mounting stand 360, shown in FIG. 17, which is  
designed to hold instant programmer 300 between left  
15 raised side 362 and right raised side 364. The instant  
programmer 300 is slid between left raised side 362 and  
right raised side 364 until coming to a stop at front  
alignment flange 365, which is at the front of mounting  
stand 360 and connected across left raised side 362 and  
20 right raised side 364, as shown in FIG. 17A. Together  
elements 362, 364 and 365 provide alignment for instant  
programmer 300 so that IR transparent cover 336 and the IR  
diodes 342, 344, 346 and 348, shown in FIG. 17 are  
properly aligned for transmission, when the instant  
25 programmer is used as shown in FIG. 20. The mounting  
stand 360 has an alignment flange 366, which has the  
purpose of aligning the back edge of mounting stand 360,  
which is defined as the edge along which alignment flange  
366 is located, along the front side of a cable box or  
30 VCR, or similar unit as shown in FIG. 20. When aligned as  
shown in FIG. 20, the mounting stand 360 aligns the  
instant programmer 300 so that the left IR diode 342, down  
IR diode 344, two back IR diodes 346 and right IR diode  
348, as shown in FIG. 17, are in position to transmit  
35 signals to video cassette recorder 370 and cable box 372,  
as necessary. If the VCR and/or cable box functions are  
located within the television 374 itself, then the instant

1 programmer 300 could be positioned to transmit to the  
television 374, either in the manner of FIG. 19 or by  
placing the mounting stand on top of the television in the  
manner of FIG. 20.

5 By using mounting stand 360, the user only need to  
align the mounting stand 360, and the instant programmer  
300 once with the equipment to be programmed rather than  
having the user remember to keep the instant programmer  
300 in the correct location to transmit via front infrared  
10 (IR) diode 340, as shown in FIG. 19. Current experience  
with various remote controllers shows that it is difficult  
at best to keep a remote controller in a fixed location,  
for example, on a coffee table. The mounting stand 360  
solves this problem by locating the instant programmer 300  
15 with the equipment to be controlled. The left IR diode  
342, down IR diode 344, two back IR diodes 346 and right  
IR diode 348 are positioned to transmit to the left,  
downward, backward, and to the right. The downward  
transmitter assumes that mounting stand 360 will be placed  
20 on top of the unit to be programmed. The left and right  
transmission allows units to the left or right to be  
programmed. The backward transmission back IR diodes 346  
are provided so that signals can bounce off walls and  
other objects in the room. The front IR diode 340, the  
25 left IR diode 342, the right IR diode 348 and the down IR  
diode 344 are implemented with 25 degree emitting angle  
diodes. Two back IR diodes are provided for greater  
energy in that direction and are implemented with 5 degree  
emitting angle diodes, which focus the energy and provide  
30 for greater reflection of the IR energy off of walls or  
objects in the room.

Most VCR's and cable boxes can be controlled by an  
infrared remote controller; however, different VCR's and  
cable boxes have different IR codes. Although there are  
35 literally hundreds of different models of VCR's and cable  
boxes, there are fortunately only tens of sets of IR  
codes. Each set may have a few tens of "words" that

1 represent the different keys required, e.g. "power",  
"record", "channel up", "channel down", "stop", "0", "1",  
"2" etc. For the purpose of controlling the VCR and cable  
box to do recording, only the following "words" are  
5 required: "0", "1", "2", "3", "4", "5", "6", "7", "8",  
"9", "power", "record", "stop". The IR codes for these  
words for all the sets are stored in the memory of the  
instant programmer 300, which is located in microcomputer  
380 of FIGs. 21 and 22. During setup of the instant  
10 programmer 300, the user interactively inputs to the  
instant programmer 300 the type and model of his VCR and  
cable box. The correct set of IR codes will be recalled  
from memory during the actual control process. In the  
case where the user only has a VCR, the infrared (IR)  
15 codes for that particular VCR will be recalled to control  
the VCR. In the case where the user has a VCR and a cable  
box, the IR codes "power", "record", "stop" will be  
recalled from the set that corresponds to the VCR whereas  
the IR codes for "0" through "9" will be recalled from the  
20 set that corresponds to the cable box. The reason is that  
in this case, the cable box controls the channel  
switching. Hence the channel switching signals "0"  
through "9" must be sent to the cable box instead of the  
VCR.

25 Initially, the user performs a setup sequence.  
First, the user looks up the number corresponding to the  
model/brand of VCR to be programmed in a table, which  
lists the VCR brand name and a two digit code. Then with  
the VCR tuned to Channel 3 or Channel 4, whichever is  
30 normally used, the user turns the VCR "OFF". Then the  
user presses the VCR key 326. When the display shows VCR,  
the user presses the two-digit code looked up in the VCR  
model/brand table (for example 01 for RCA). The user  
points the instant programmer 300 at the VCR and then  
35 presses ENTER key 318. The red warning light emitting  
diode 332 will flash while it is sending a test signal to  
the VCR. If the VCR turned "ON" and changed to Channel

1 09, the user presses the SAVE key 316 and proceeds to the  
set clock step. If the VCR did not turn "ON" or turned  
"ON" but did not change to Channel 09 the user presses  
ENTER key 318 again and waits until red warning light  
5 emitting diode 332 stops flashing. The instant programmer  
300 sends the next possible VCR code, while the red  
warning light emitting diode 332 is flashing. If the VCR  
turns "ON" and changed to Channel 09 the user presses SAVE  
key 316, otherwise the user presses ENTER key 318 again  
10 until the VCR code is found that works for the VCR. The  
display shows "END" if all possible VCR codes for that  
brand are tried. If so, the user presses VCR key 326 code  
00 and then ENTER key 318 to try all possible codes, for  
all brands, one at a time.

15 Once the proper VCR code has been found and saved,  
the next setup step is to set the clock on instant  
programmer 300. First, the user presses the CLOCK key  
320. When the display shows: "YR:", the user presses the  
year (for example 90), then presses ENTER key 318. Then  
20 the display shows "MO:", and the user presses the month  
(for example 07 is July), and then presses ENTER key 318.  
This is repeated for "DA:" date (for example 01 for the  
1st), "Hr:" hour (for example 02 for 2 o'clock), "Mn:"  
minute (for example 05 for 5 minutes), and "AM/PM:" 1 for  
25 AM or 2 for PM. After this sequence, the display will  
show "SAVE" for a few seconds and then the display will  
show the current time and date that have been entered. It  
is no longer necessary for the user to set the clock on  
his/her VCR.

30 Next, if the instant programmer 300 is also to be  
used as a cable box controller, then the setup steps are  
as follows. First, the number corresponding to the  
model/brand of cable box (converter) to be controlled is  
looked up in a cable box model brand table, that lists  
35 cable box brands and corresponding two digit codes. The  
VCR is tuned to Channel 03 or 04 and turned "OFF". Then  
the cable box is tuned to Channel 02 or 03, whichever is

1 normal, and left "ON". Then the CABLE key 328 is pressed.  
When the display shows: "CA B-:" the user enters the two  
digit code looked up in cable box model brand table,  
points the instant programmer 300 at the cable box  
5 (converter) and presses ENTER key 318. The red warning  
light emitting diode 332 will flash while it is sending a  
test signal to the cable box. If the cable box changed to  
Channel 09: then the user presses SAVE key 316; however,  
if the cable box did not change to Channel 09 the user  
10 presses ENTER key 318 again and waits until red warning  
light emitting diode 332 stops flashing, while the next  
possible code is sent. This is repeated until the cable  
box changes to Channel 09 and when it does the user  
presses SAVE key 316. If the display shows "END" then the  
15 user has tried all possible cable box codes for that  
brand. If so, the user presses cable code 00 and then  
ENTER key 318 to try all possible brand's codes, one at a  
time.

For some people (probably because they have cable or  
20 satellite), the channels listed in their television guide  
or calendar are different from the channels on their  
television or cable. If they are different, the user  
proceeds as follows. First, the user presses the CH key  
322. The display will look like this: "Guide CH TV CH".  
25 Then the user presses the channel printed in the  
television guide or calendar (for example, press 02 for  
channel 2), and then the user presses the channel number  
that the printed channel is received on through his/her  
local cable company. Then the user presses ENTER key 318.  
30 This is repeated for each channel listing that is on a  
different channel than the printed channel. When this  
procedure is finished the user presses SAVE key 316.

Typically the television guide or calendar in the  
area will have a chart indicating the channel number that  
35 has been assigned to each Cable and broadcast channel, for  
example: HBO, CNN, ABC, CBS, NBC, etc. This chart would  
correspond, for example, to the left two columns of FIG.

1 28. For example, suppose the television guide or calendar  
has assigned channel 14 to HBO but the user's cable  
company delivers HBO on channel 18. Since the channel  
5 numbers are different, the user needs to use the CH key  
322. The user will press the CH button (the two blank  
spaces under the display "Guide CH" will flash). The user  
then presses 14. (now the two blank spaces under the  
display "TV CH" will flash). The user then presses 18 and  
then ENTER key 318. This is repeated for each channel  
10 that is different. When finished, the user presses SAVE  
key 316.

After the channel settings have been saved, the user  
may review the settings by pressing CH key 322 and then  
REVIEW key 306. By repeated pressing of the REVIEW key  
15 306 each of the set channels will scroll onto the display,  
one at a time.

Then the user can test to make sure that the location  
of the instant programmer 300 is a good one. First, the  
user makes sure that the VCR is turned "OFF" but plugged  
20 in and makes sure that the cable box (if there is one) is  
left "ON". Then the user can press the TEST key 330. If  
there is only a VCR, then if the VCR turned "ON", changed  
to channel 09 and started recording, and then turned  
"OFF", then the VCR controller is located in a good place.

25 If there is also a cable box, then if the VCR turned  
"ON", the cable box turned to channel 09 and the VCR  
started recording, and then the VCR stopped and turned  
"OFF", then the instant programmer 300 is located in  
good place.

30 To operate the instant programmer 300, the VCR should  
be left OFF and the cable box ON. The user looks up in  
the television guide the compressed code for the program,  
which he/she wishes to record. The compressed code 212 is  
listed in the television guide, as shown in FIG. 8. The  
35 television guide/calendar that would be used with this  
embodiment would have the same elements as shown on FIG.  
8 except that element 188 of FIG. 8 is not required. The

1 compressed code 212 for the program selected by the user  
is entered into the instant programmer 300 by using the  
number keys 302 and then the user selects how often to  
record the program. The user presses the ONCE key 310 to  
5 record the program once at the scheduled time, or the user  
presses the WEEKLY key 308 to record the program every  
week at the same scheduled time until cancelled or the  
user presses the DAILY (M-F) key 312 to record the program  
each day Monday through Friday at the same scheduled time  
10 until cancelled. This is most useful for programs such as  
soapbox operas that air daily, but not on the weekend. To  
confirm the entry, the instant programmer 300 will  
immediately decode the compressed code and display the  
date, channel and start time of the program entered by the  
15 user. The length of the entered program is also displayed  
by time bars 352 that run across the bottom of the  
display. Each bar represents one hour (or less) of  
program.

Then the user just needs to leave the instant  
20 programmer 300 near the VCR and cable box so that commands  
can be transmitted, and at the right time, the instant  
programmer 300 will turn "ON" the VCR, change to the  
correct channel and record the program and then turn the  
VCR "OFF". The user must just make sure to insert a blank  
25 tape.

The REVIEW key 306 allows the user to step through  
the entered programs. These are displayed in  
chronological order, by date and time. Each time the  
REVIEW key 306 is pressed, the next program is displayed,  
30 until "END" is displayed, when all the entered programs  
have been displayed. If the REVIEW key 306 is pressed  
again the display will return to the current date and  
time.

If the user wishes to cancel a program, then the user  
35 presses REVIEW key 306 until the program to cancel is  
displayed, then the user presses CANCEL key 304. The  
display will say "CANCELLED". Also, any time the user



1 presses a wrong number, pressing the CANCEL key 304 will  
allow the user to start over.

5 Certain television programs, such as live sports, may  
run over the scheduled time slot. To ensure that the  
entire program is recorded, the user may press the ADD  
TIME key 324 to increase the recording length, even while  
the program is being recorded. The user presses the  
REVIEW key 306 to display the program, then presses ADD  
TIME key 324. Each time ADD TIME key 324 is pressed, 15  
10 minutes is added to the recording length.

When the current time and date is displayed, the  
amount of blank tape needed for the next 24 hours is also  
displayed by the time bars 352 that run across the bottom  
of the display. Each bar represents one hour (or less) of  
15 tape. The user should check this before leaving the VCR  
unattended to ensure that there is enough blank tape.

Each time a program code is entered, the instant  
programmer 300 automatically checks through all the  
entries to ensure that there is no overlap in time between  
20 the program entries. If the user attempts to enter a  
program that overlaps in time with a program previously  
entered, then the message "CLASH" appears. Then, as  
summarized by step 432 of FIG. 23, the user has the  
following options: 1) if the user wishes to leave the  
25 program previously entered and forget about the new one,  
the user does nothing and after a short time delay, the  
display will return to show the current time and date; 2)  
if the user wishes the program which starts first to be  
recorded to its end, and then to record the remainder of  
30 the second program, then the user presses ONCE key 310,  
DAILY (M-F) key 312, or WEEKLY key 308 again (whichever  
one the user pushed to enter the code). If the programs  
have the same starting time, then the program most  
recently entered will be recorded first. If on being  
35 notified of the "CLASH", the user decides the new program  
is more important than the previously entered program,

1 then the user can cancel the previously entered program  
and then re-enter the new one.

5 In some locations, such as in some parts of Colorado,  
the cable system airs some channels three (3) hours  
later/earlier than the times listed in the local  
television guide. This is due to time differences  
depending on whether the channel is received on a east or  
west satellite feed. For the user to record the program  
3 hours later than the time listed in the television guide  
10 the procedure is as follows. First the user enters the  
code for the program and then presses SAVE key 316 (for +)  
and then presses ONCE key 310, DAILY (M-F) key 312, or  
WEEKLY key 308, as desired. For the user to record the  
program 3 hours earlier than the time listed in the  
15 television guide the procedure is as follows. First the  
user enters the code for the program and then presses  
ENTER key 318 (for -) and then presses ONCE key 310, DAILY  
(M-F) key 312, or WEEKLY key 308, as desired. The instant  
programmer 300 will display the time that the program will  
20 be recorded, not the time shown in the television guide.

There are certain display messages to make the  
instant programmer 300 more user friendly. The display  
"LO BATT" indicates that the batteries need replacement.  
"Err: ENTRY" indicates an invalid entry during set up.  
25 "Err: CODE" indicates that the program code number entered  
is not a valid number. If this is displayed the user  
should check the television guide and reenter the number.  
"Err: DATE" indicates the user may have: tried to select  
a daily recording (Monday to Friday) for a Saturday or  
30 Sunday program; tried to select weekly or daily recording  
for a show more than 7 days ahead, because the instant  
programmer 300 only allows the weekly or daily recording  
option to be used for the current weeks' programs ( $\pm 7$   
days); or tried to enter a program that has already ended.  
35 "FULL" indicates that the stack storage of the programs to  
be recorded, which is implemented in random access memory  
(RAM) inside the instant programmer 300 has been filled.

1 The user could then cancel one or more programs before  
entering new programs. "EMPTY" indicates there are no  
programs entered to be recorded. The number of programs  
to be recorded that can be stored in the instant  
5 programmer 300 varies depending on the density of RAM  
available and can vary from 10 to more.

FIG. 21 is a schematic of the circuitry needed to  
implement the instant programmer 300. The circuitry  
consists of microcomputer 380, oscillator 382, liquid  
10 crystal display 384, key pad 386, five way IR transmitters  
390 and red warning light emitting diode 332. The  
microcomputer 380 consists of a CPU, ROM, RAM, I/O ports,  
timers, counters and clock. The ROM is used for program  
storage and the RAM is used among other purposes for stack  
15 storage of the programs to be recorded. The liquid  
crystal display 384 is display 350 of FIGs. 15 and 18.  
The key pad 386 implements all the previously discussed  
keys. The five way IR transmitters 390 consists of front  
infrared (IR) diode 340, left IR diode 342, down IR diode  
20 344, two back IR diodes 346 and right IR diode 348. FIG.  
22 shows the detailed schematic of the instant programmer  
300 circuitry and previously identified elements are  
identified by the same numbers. The microcomputer can be  
implemented with a NEC  $\mu$ PD7530x part, which can interface  
25 directly with the display, the keypad, the light emitting  
diodes and the oscillator. The 25 degree IR diodes can be  
implemented with NEC 313AC parts and the 5 degree IR  
diodes can be implement with Litton 2871C IR diodes.

The flow charts for the program that is stored in the  
30 read only memory (ROM) of the microcomputer 380 that  
executes program entry, review and program cancellation,  
and record execution are illustrated in FIGs. 23, 24, and  
25, respectively. The FIG. 23 for program entry, which  
process was described above, consists of the following  
35 steps: display current date, time and time bars step 402,  
which is the quiescent state of instant programmer 300;  
scan keyboard to determine if numeric decimal compressed

1 code entered step 404; display code as it is entered step  
406; user checks if correct code entered step 408 and user  
presses CANCEL key 304 step 428; user advances or retards  
start time by three hours by pressing SAVE key 316 or  
5 ENTER key 318 step 410; user presses ONCE key 310, WEEKLY  
key 308 or DAILY key 312 key step 412; microcomputer  
decodes compressed code into CDTL step 414; test if  
conflict with stored programs step 416, if so, display  
"CLASH" message step 420, user presses ONCE key 310,  
10 WEEKLY key 308 or DAILY key 312 step 422, then accommodate  
conflicting entries step 432, as described above in the  
discussion of the "CLASH" options, and entry not saved  
step 424; set display as date, channel, start time and  
duration (time bars) for ONCE, or DA, channel, start  
15 time and duration for DAILY, or day of week, channel, start  
time and duration for WEEKLY step 418; user presses ADD  
TIME key 324, which adds 15 minutes to record time step  
426; user checks display step 430; enter program on stack  
in chronological order step 434 wherein the stack is a  
20 portion of the RAM of microcontroller 380; and calculate  
length of tape required and update time bars step 436.

The FIG. 24 flowchart for review and cancellation,  
which process was described above, consists of the  
following steps: display current date, time and time bars  
25 step 402; REVIEW key 306 pressed step 442; test if stack  
empty step 444, display "EMPTY" step 446, and return to  
current date and time display step 448; display top stack  
entry step 450; user presses ADD TIME key 324 step 452 and  
update time bars step 460; user presses REVIEW key 306  
30 step 454 and scroll stack up one entry step 462; user  
presses CANCEL key 304 step 456 and display "CANCELLED"  
and cancel program step 464; and user does nothing step  
458 and wait 30 seconds step 466, wherein the 30 second  
timeout can be implemented in the timers of microcomputer  
35 380.

The FIG. 25 flowchart for record execution, which is  
the process of automatically recording a program and which

1 was described above, consists of the following steps:  
compare start time of top program in stack memory with  
current time step 472; test if three minutes before start  
time of program step 474; start red warning LED 332  
5 blinking for 30 seconds step 476; display channel, start  
time and blinking "START" message step 478, is correct  
start time reached step 480 and send power ON signal to  
VCR and display "REC" message step 482; test if a cable  
box is input to VCR step 484, send channel switching  
10 signals to VCR step 486 and send channel switching signals  
to cable box step 488; send record signals to VCR step  
490; compare stop time with current time step 492, test if  
stop time reached step 494 and display "END" message step  
496; send stop signals to VCR step 498; send power OFF  
15 signal to VCR step 500; and pop program stack step 502.

FIG. 26 is a flowchart of the method for encoding  
channel, date, time and length (CDTL) into decimal  
compressed code 510. This process is done "off-line" and  
can be implemented on a general purpose computer and is  
20 done to obtain the compressed codes 212 that are included  
in the program guide or calendar of FIG. 8. The first  
step in the encoding method is the enter channel, date,  
time and length (CDTL) step 512 wherein for a particular  
program the channel, date, start time and length CDTL 514  
25 of the program are entered. The next step is the look up  
assigned channel number step 516, which substitutes an  
assigned channel number 522 for each channel 518. Often,  
for example for network broadcast channels, such as  
channel 2, the assigned channel number is the same;  
30 however, for a cable channel such as HBO a channel number  
is assigned and is looked up in a cable assigned channel  
table 520, which would essentially be the same as the  
first two columns of the table of FIG. 28. Next, the look  
up priority of channel, date and time/length in priority  
35 vector tables step 524 performs a look up in priority  
vector channel (C) table 526, priority vector date (D)  
table 528 and priority vector time/length (TL) table 530

1 using the indices of channel, date and time/length,  
respectively, to produce the vector C<sub>p</sub>, D<sub>p</sub>, TL<sub>p</sub> 532. The  
use of a combined time/length (TL) table to set priorities  
5 recognizes that there is a direct relationship between  
these combinations and the popularity of a program. For  
example, at 6:30 PM, a short program is more likely to be  
popular than a 2 hour program, because it may be the  
dinner hour.

10 The channel priority table is ordered so that the  
most frequently used channels have a low priority number.  
An example of the data that is in the priority vector C  
table 526 follows.

15           channel   4    7    2    3    5    6    11   13 ...  
             priority 0    1    2    3    4    5    6    7 ...

20           Generally the dates of a month all have an equal  
priority or equal usage, so the low number days in a month  
and the low number priorities would correspond in the  
priority vector D table 528 as in the following example.

             date       1    2    3    4    5    6    7    8 ...  
             priority 0    1    2    3    4    5    6    7 ...

25           The priority of the start times and length of the  
programs could be arranged in a matrix that would assign  
a priority to each combination of start times and program  
lengths so that more popular combinations of start time  
and length would have a low priority number and less  
30 popular combinations would have a high priority number.

1 For example, a partial priority vector T/L table 530 might appear as follows.

Priority TL Table					
TIME	6:30pm	7:00pm	7:30pm	8:00pm	...
5 Length (hrs)					
.5	8	4	7	10	
1.0	12	15	13	18	
1.5	20	19	17	30	

10 Suppose the channel, date, time and length (CDTL) 514 data is channel 5, February 10, 1990, 7:00PM and 1.5 hours in length, then the  $C_p, D_p, TL_p$  data 532 for the above example would be 4 9 19. The next step is the convert  $C_p, D_p, TL_p$  to binary numbers and concatenate them into one binary number step 534, resulting in the data word  $...TL_p TL_p ... C_p C_p ... D_p D_p$  536. For the example given above, converting the  $...TL_p TL_p ... C_p C_p ... D_p D_p$  536 word to binary would yield the three binary numbers:  $...0010011, ...0100, ...01001$ . The number of binary bits to use in each conversion is determined by the number of combinations involved. This could vary depending on the implementation; however one preferred embodiment would use eight bits for  $C_p$ , denoted as  $C_7 C_6 C_5 C_4 C_3 C_2 C_1$ , which would provide for 256 channels, five bits for  $D_p$ , which can be denoted as  $D_4 D_3 D_2 D_1$ , would provide for 31 days in a month, and fourteen bits for  $TL_p$ , denoted as  $TL_{14} ... TL_7 TL_6 TL_5$ , which would provide for start times spaced every 5 minutes over 24 hours and program lengths in increments of 5 minute lengths for programs up to 3 hours in length and program length in increments of 15 minute lengths for programs from 3 to 8 hours in length. This requires about  $288 \times (36+20) = 16,128$  combinations, which are provided by the  $2^{14} = 16,384$  binary combinations. Altogether there are  $8+5+14 = 27$  bits of information  $TL_{14} ... TL_7 TL_6 TL_5 ... C_7 C_6 C_5 C_4 C_3 C_2 C_1 D_4 D_3 D_2 D_1$ . For the above example padding each number with zeros and then concatenating them would

1     yield   the   27   bit   binary   number :  
000000000100110000010001001.

5     The next step is to use bit hierarchy key 540, which  
can be stored in read only memory 64 to perform the  
reorder bits of binary number according to bit hierarchy  
key step 538. As described previously, a bit hierarchy  
key 540 can be any ordering of the ...TL<sub>7</sub>TL<sub>1</sub>...C<sub>7</sub>C<sub>1</sub>...D<sub>7</sub>D<sub>1</sub>,  
536 bits and in general will be selected so that programs  
most likely to be the subject of timer preprogramming  
10     would have a low value compressed code 212, which would  
minimize keystrokes. The ordering of the bit hierarchy  
key can be determined by the differential probabilities of  
the various bit combinations as previously discussed. The  
details of deriving a bit hierarchy key 540 were described  
15     relative to bit hierarchy key 120 and the same method can  
be used for bit hierarchy key 540. For example, the bit  
hierarchy key might be:

20                    TL<sub>7</sub> C<sub>7</sub>   ... TL<sub>10</sub> C<sub>7</sub> TL<sub>1</sub> C<sub>1</sub> L<sub>1</sub> D<sub>7</sub> D<sub>4</sub> D<sub>3</sub> D<sub>2</sub> D<sub>1</sub>  
                     27 26   ... 10   9   8   7   6   5   4   3   2   1

25     The next step is the combine groups of bits and  
convert each group into decimal numbers and concatenate  
into one decimal number step 542. For example, after  
reordering according to the bit hierarchy key, the code  
may be 000000001010010000010001001, which could be grouped  
as 00000000101001000,0010001001. If these groups of  
binary bits are converted to decimal as 328,137 and  
30     concatenated into one decimal number, then the resulting  
decimal number is 328137. The last encoding step is the  
permute decimal number step 546, which permutes the  
decimal number according to permutation function 544 that  
is dependent on the date 548 and in particular the month  
and year and provides a security feature for the codes.  
35     After the permute decimal number step 546, the decimal  
compressed code G<sub>1</sub>...G<sub>7</sub>G<sub>1</sub>, 550 may, for example, be 238731.



1     These encoded codes are then included in a program guide  
or calendar as in the compressed code indication 212 of  
FIG. 8.

5     FIG. 27 is a flowchart of the method for decoding a  
decimal compressed code into channel, date, time and  
length 560, which is step 414 of FIG. 23. Once the  
decimal compressed code  $G_1 \dots G_n G_n$  564 is entered in step  
562, it is necessary to invert the permutation function of  
steps 544 and 546 of FIG. 26. The first step is the  
10    extract day code step 566, which extracts the day code for  
the program in the decimal compressed code and passes the  
day code to step 568, which also receives the current day  
574 from the clock 576, which is implemented by  
microcomputer 380 in FIGs. 21 and 22. The clock 576 also  
15    sends the current month and year to the permutation  
function 570, which is dependent on the month and year.  
Then step 568 performs the function: if day code is same  
or greater than current day from clock, then use  
permutation function for month/year on clock, otherwise  
20    use permutation function for next month after the month on  
the clock and use next year if the month on the clock is  
December. In other words, since there is provision for  
preprogramming recording for one month or 31 days ahead,  
if the day for the program is equal to or greater than the  
25    current day of the month, then it refers to a day in the  
present month; otherwise, if the day for the program is  
less than the current day of the month, it must refer to  
a program in the next month. The extract day code step  
566, which must be performed before the invert permutation  
30    of decimal compressed code step 580, is accomplished by a  
prior knowledge of how the permute decimal number step 546  
of FIG. 26 is performed relative to the day code  
information.

35    The selected permutation method 578 is used in the  
invert permutation of decimal compressed code step 580.  
For the example given above, the output of step 580 would

1 be: 328137. The next step is the convert groups of  
decimal numbers into groups of binary numbers and  
concatenate binary groups into one binary number step 584,  
which is the inverse of step 542 of FIG. 26 and for the  
5 above example would result in the binary code:  
000000001010010000010001001. Then the bit hierarchy key  
588 is used in the reorder bits of binary number according  
to bit hierarchy key step 586, which inverts step 538 of  
FIG. 26 to obtain 00000000100110000010001001 for the  
10 above example, which is  $\dots TL_1 TL_1 \dots C_1 C_1 \dots D_1 D_1$  582  
corresponding to 536 of FIG. 26. The next step is to  
group bits to form three binary numbers  $TL_0$ ,  $C_0$ ,  $D_0$  and  
convert to decimal numbers step 590 resulting in  $C_p$ ,  $D_p$ ,  
 $TL_p$  592, which for the example above would be: 4, 9, 19,  
15 and which are priority vectors for channel, day and  
time/length, which in turn are used to look up channel,  
day, time and length 604 in priority vector channel (C)  
table 598, priority vector date (D) table 600, and  
priority vector time/length (TL) table 602, respectively.  
20 The look up local channel number step 606 looks up  
the local channel 612 given the assigned channel number  
608, in the assigned/local channel table 610, which is  
setup by the user via the CH key 322, as explained above.  
An example of the assigned/local channel table 610 is the  
25 right two columns of the assigned/local channel table 620  
of FIG. 28. The correspondence between the assigned  
channel numbers, such as 624 and 628, and the local  
channel numbers, such as 626 and 630 is established during  
setup by the user. For the example, FIG. 28 shows an  
30 exact correspondence between the assigned channel number  
5 and the local channel number 5. The last step is the  
append month and year to day to form date step 614. The  
correct month and year are obtained from step 568 and are  
again dependent on whether the day code is equal to or  
35 greater than the day from the clock or less than the day  
from the clock. If the day code is equal to or greater

1     than the day from the clock, the month and year as shown  
on the clock are used, otherwise the next month is used  
and the next year is used if the clock month is December.  
The result is the channel, date, time and length (CDTL)  
5     618, which for the above example would be channel 5,  
February 10, 1990, 7:00PM and 1.5 hours in length.

Another preferred embodiment is to embed the decoding  
means into a television receiver with G-code decoder 950,  
as shown in FIG. 29, which is a block diagram of a system  
10     including a television receiver having a G-code decoder.  
The user would use the television remote controller 956 or  
controls on the television receiver to enter the code that  
signifies the program to be recorded. The same television  
remote and controls on the television would also be used  
15     to perform normal television control functions, such as  
channel selection. When a G-code is entered, the  
television remote would send the G-code to the television  
with G-code decoder 950 via infrared transmitter 958. An  
infrared receiver 960 on the television receiver 950 would  
20     receive the transmission and send the code to the G-code  
decoder 954, which would decode the code into CDTL and use  
this information along with a clock, which would also be  
embedded in the television receiver 950, to send the  
proper commands to the VCR 964 and cable box 966 at the  
25     appropriate time so that the selected program will be  
recorded at the proper time. The transmission from the  
television 950 would be via infrared transmitters 962,  
which can be placed at strategic points on the television  
cabinet, such as at the corners. The transmission is then  
30     received by the VCR 964 via infrared receiver 968 and the  
cable box 966 via infrared receiver 969.

FIG. 30 is a schematic of a television receiver  
having a G-code decoder. The television receiver with  
G-code decoder 950 would receive signals from the  
35     television remote controller 956 via infrared receiver  
960, which would send the signals to either command  
controller 974 or directly to G-code decoder 954. The

1 command controller 974 may be present in the television  
receiver to control other items in the television,  
including "on screen" functions such as displaying the  
channel number when the channel is changed. The G-code  
5 decoder 954 would decode a sent G-code and using the date  
and time from clock 976 would send the proper commands to  
the VCR 964 and cable box 966 via infrared transmitters  
962. The G-codes and other commands could also be sent to  
the command controller via manual control 975. When the  
10 G-code is decoded, then the G-code and the decoded CDTL  
information could be displayed "on screen" as shown in on  
screen display 978 on television display/monitor 952. The  
"on screen" display is not necessary and any format is  
optional.

15 FIG. 31 is a schematic showing apparatus for a G-code  
decoder in a television receiver having G-code decoding.  
The circuitry is very similar to that described in FIGs.  
21 and 22; however, there are interfaces to an infrared  
receiver 960 and command controller 974 rather than LCD  
20 384 and Key Pad 386. The key elements are microcontroller  
980 and oscillator 982. The interface to command  
controller 974 is one preferred embodiment; another  
embodiment could have direct interfaces between the manual  
control 975, the infrared receiver 960, the television  
25 display/monitor 952 and the G-code decoder 954 without  
going through the intermediary command controller 974.  
The television circuitry would include the capability of  
storing or learning the infrared code protocols for the  
VCR and the cable box. The warning light emitting diode  
30 984 would be mounted on the cabinet of the television to  
warn that recording was about to begin in order to alert  
the user to have the VCR ready with tape to record.

With the "on screen" display on television  
display/monitor 952, the operation of the television  
35 receiver with G-code decoder 950 can be essentially  
identical to that described in FIGs. 23, 24 and 25 for  
program entry, program review and program cancellation,

1 and execution of recorder preprogramming using compressed  
codes, respectively. Every that was displayed on LCD 384  
would instead be displayed on the television monitor 952.  
The only difference would be that "on screen" would only  
5 perform step 402 (display current date, time and time  
bars) when the user put television remote controller 956  
into a mode for G-code entry and transmission, program  
review or program cancellation. The method of encoding  
program channel, date, time and length information into  
10 decimal compressed codes of FIG. 26, the method of  
decoding decimal compressed codes into program channel,  
date, time and length information of FIG. 27, and the  
method of assigning channel numbers to local channel  
numbers as illustrated in FIG. 28 would stay the same.

15 Another preferred embodiment of the invention is to  
embed the decoding means into various equipments  
associated with television, such as a video cassette  
recorder, cable box or satellite receiver. In any system  
the decoding means would only have to be present in one of  
20 the equipments, such as the cable box, which would then at  
the appropriate time distribute the proper commands to the  
other equipments such as a VCR and a satellite receiver to  
record the desired program.

FIG. 32 is a block diagram of a system including a  
25 television having a G-code decoder 950, a VCR 964, a cable  
box 966 and a satellite receiver 986. This system would  
work identically to the system shown in FIG. 29, except  
that a satellite receiver is included, which could receive  
commands via infrared receiver 988 from infrared  
30 transmitters 962 mounted on television receiver with  
G-code decoder 950. The commands received by the  
satellite receiver could include on/off commands and  
channel select commands. The satellite receiver 986 could  
feed a television signal to VCR 964, which would record  
35 the program and/or relay it to television display/monitor  
952.

1           FIG. 33 is a block diagram of a system including a  
VCR having a G-code decoder 991, a television 952, a cable  
box 966 and a satellite receiver 986. The user would use  
the television remote controller 956 or controls on the  
5       VCR 991 to enter the code that signifies the program to be  
recorded. When a G-code is entered, the television remote  
would send the G-code to VCR 991 with G-code decoder 992  
via infrared transmitter 958. An infrared receiver 990 on  
the VCR 991 would receive the transmission and send the  
10      code to the G-code decoder 992, which would decode the  
code into CDTL and use this information along with a  
clock, which would also be embedded in the VCR 991, to  
send the proper commands to the cable box 966 and the  
satellite receiver 986 at the appropriate time so that the  
15      selected program will be recorded at the proper time. The  
transmission from the VCR 991 would be via infrared  
transmitters 994, which can be placed at strategic points  
on the VCR. The transmission is then received by the  
cable box 966 via infrared receiver 969 and the satellite  
20      receiver 986 via infrared receiver 988.

Another preferred embodiment of the transmission  
method and apparatus between equipments is shown in FIG.  
36, which is a perspective view showing a cable box 372  
placed on top of a VCR 370 having an infrared transmitter  
1008 behind the front panel 1009 which communicates to the  
25      cable box infrared receiver 1010 via reflection from  
surrounding reflecting surfaces such as walls.

Another preferred embodiment of the transmission  
method and apparatus between equipments is shown in FIG.  
30      37, which is a perspective view showing a cable box 372  
placed on top of a VCR 370 having an infrared transmitter  
1014 inside a infrared dome 1012 on the top of the VCR  
which communicates to the cable box infrared receiver 1010  
via direct communication or reflection depending on  
35      placement of the infrared receiver 1010 relative to  
infrared dome 1012.

1        Another preferred embodiment of the transmission  
method and apparatus between equipments is shown in FIG.  
38, which is a perspective view of a VCR 370 having an  
infrared transmitter 1022 inside a mouse 1020 coupled via  
5       a cable 1018, which is plugged via plug 1017 into  
receptacle 1016 on the VCR. The mouse 1020 is placed near  
the cable box infrared receiver 1010. This embodiment is  
most useful when the cable box is separated from the VCR  
by walls of a cabinet, for example, that would prevent  
10       either direct or reflective infrared transmission.

Another preferred embodiment of the transmission  
method and apparatus between equipments is shown in FIG.  
39, which is a perspective view of a VCR 370 having an  
infrared transmitter 1026 inside a stick on miniature  
15       mouse 1024 coupled via a cable 1018, which is plugged via  
plug 1017 into receptacle 1016 on the VCR. The stick on  
miniature mouse 1024 is stuck onto the cable box very near  
the infrared receiver 1010. This embodiment is also most  
useful when the cable box is separated from the VCR by  
20       walls of a cabinet, for example, that would prevent either  
direct or reflective infrared transmission.

The transmission methods and apparatus of FIGs. 36,  
37, 38 and 39 could also be used with the system of FIG.  
32 to transmit information from television receiver with  
25       G-code decoder 950 to VCR 964, cable box 966 and satellite  
receiver 986.

FIG. 34 is a block diagram of a system including a  
cable box having a G-code decoder 997, a television 952  
a VCR 964, and a satellite receiver 986. The user would  
30       use the television remote controller 956 or controls on  
the cable box 997 to enter the code that signifies the  
program to be recorded. When a G-code is entered, the  
television remote would send the G-code to cable box 997  
with G-code decoder 998 via infrared transmitter 958. An  
35       infrared receiver 996 on the cable box 997 would receive  
the transmission and send the code to the G-code decoder  
998, which would decode the code into CDTL and use this

1 information along with a clock, which would also be  
embedded in the cable box 997, to send the proper commands  
to the VCR 964 and the satellite receiver 986 at the  
appropriate time so that the selected program will be  
5 recorded at the proper time. The transmission from the  
cable box 997 would be via infrared transmitters 1000,  
which can be placed at strategic points on the cable box.  
The transmission is then received by the VCR 964 via  
infrared receiver 968 and the satellite receiver 986 via  
10 infrared receiver 988. The transmission methods and  
apparatus of FIGs. 36, 37, 38 and 39 could also be used  
with the system of FIG. 34 to transmit information from  
cable box 997 to VCR 964 and satellite receiver 986.

FIG. 35 is a block diagram of a system including a  
15 satellite receiver 1005 having a G-code decoder, a  
television 952, a VCR 964, and a cable box 966. The user  
would use the television remote controller 956 or controls  
on the satellite receiver 1005 to enter the code that  
signifies the program to be recorded. When a G-code is  
20 entered, the television remote would send the G-code to  
satellite receiver 1005 with G-code decoder 1004 via  
infrared transmitter 958. An infrared receiver 1002 on  
the satellite receiver 1005 would receive the transmission  
and send the code to the G-code decoder 1004, which would  
25 decode the code into CDTL and use this information along  
with a clock, which would also be embedded in the  
satellite receiver 1005, to send the proper commands to  
the VCR 964 and the cable box 966 at the appropriate time  
so that the selected program will be recorded at the  
30 proper time. The transmission from the satellite receiver  
1005 would be via infrared transmitters 1006, which can be  
placed at strategic points on the satellite receiver. The  
transmission is then received by the VCR 964 via infrared  
receiver 968 and the cable box 966 via infrared receiver  
35 969. The transmission methods and apparatus of FIGs. 36,  
37, 38 and 39 could also be used with the system of FIG.



1 35 to transmit information from satellite receiver 1005 to  
VCR 964 and cable box 966.

5 Another preferred embodiment of an apparatus for  
using compressed codes for a recorder programming is the  
custom programmer 1100 of FIGS. 40 and 41. The custom  
programmer 1100 is similar to instant programmer 300 and  
has number keys 1102, which are numbered 0-9, a CANCEL key  
1104, a REVIEW key 1106, a WEEKLY key 1108, a ONCE key  
1110 and a DAILY (M-F) key 1112, which correspond directly  
10 to keys 302-312 of instant programmer 300, and which are  
used to program the custom programmer 1100. Like the  
instant programmer 300, a lid normally covers other keys,  
which are used to set up the instant custom programmer  
1100. When lid 1114 is lifted, the following keys are  
15 revealed, but not shown in the drawings: SAVE key, ENTER  
key, CLOCK key, CH key, ADD TIME key, VCR key, CABLE key,  
and TEST key. These keys of the custom programmer 1100  
correspond to and operate substantially the same as keys  
316-330 of instant programmer 300, respectively. Also  
20 included in the custom programmer 1100 shown in FIG. 40  
are: liquid crystal display 1134, red warning light  
emitting diode 1132 and IR diodes 1134, which correspond  
to liquid crystal display 350, red warning light emitting  
diode 332 and IR diodes 342-348 as shown in FIG. 15.

25 As discussed above, when using the instant programmer  
300, the consumer initially performs a set-up sequence,  
consisting of selecting a protocol for the model/brand of  
VCR, setting the current real time, selecting a protocol  
for the model/brand of cable box, and entering a series of  
30 channel number assignments. Although the instant  
programmer 300 makes recording of television programs  
extremely simple, the initial set-up sequence for the  
instant programmer 300 is more complex and deters the use  
of the instant programmer by some consumers. Custom  
35 programmer 1100 includes a microphone opening 1140 through  
which at least one microphone inside the custom programmer  
1100 can receive electronically coded audio signals that

1 contain the information necessary for the custom  
programmer's initial set-up and commands to store this  
information into the custom programmer 1100.

5 In order to receive these audio signals, a user may  
call a special phone number which could be a toll-free 800  
number, a pay-per-minute 900 number, or a standard  
telephone number with standard toll charges applying. The  
consumer can speak to an operator who orally inquires from  
10 the consumer the information regarding the consumer's VCR  
model and brand, zip code, model and brand of cable box  
and the newspaper or other publication which the consumer  
will use to obtain the compressed codes. This is all the  
information needed to perform the initial set-up for the  
custom programmer 1100. From the zip code information,  
15 the operator can determine to which cable system the  
consumer is connected and can combine this data with the  
knowledge of which publication the consumer will use to  
select the correct local channel mapping table for the  
consumer.

20 The operator then directs the consumer to press a  
designated programming key which is, in the case of the  
preferred embodiment, the CH key located under lid 1114.  
When the CH key is pressed, the display 1134 with display  
the message "PHONE1 KEY2". Pressing the "2" numeric key  
25 places the custom programmer into the manual local channel  
table programming mode that is implemented by instant  
programmer 300 when CH key 322 is pressed. Pressing the  
"1" numeric key initiates the remote programming mode.  
The custom programmer 1100 is then ready to receive an  
30 audio signal and display 1134 displays the message "WAIT".

The operator will then direct the consumer to place  
the earpiece 1142 of the telephone receiver 1144 over the  
microphone opening 1140 of the custom programmer 1100 as  
generally shown in FIG. 42. The earpiece need not be  
35 placed directly against the custom programmer 1100, but  
may be held more than an inch away from the microphone  
opening with generally satisfactory results. After a pause

1 sufficient to allow the consumer to place the telephone  
receiver in the proper position, the operator will  
initiate the downloading of the initial set-up data and  
initial set-up programming commands transmitted over the  
5 telephone line 1146 using audio signals to the consumer's  
custom programmer 1100.

If the initial set-up data is successfully  
transferred to the custom programmer 1100, the display  
1134 of the custom programmer 1100 will display the  
10 message "DONE". If the reception of the initial set-up  
data is not successful within a predetermined time limit,  
red warning light emitting diode 1132 will blink to inform  
the consumer to adjust the position of the telephone  
earpiece before another down load of the information is  
15 attempted. After a waiting period allowing this  
adjustment, the initial set-up data and commands are  
re-transmitted over the telephone line. If after a  
predetermined number of attempts to download the initial  
set-up information are unsuccessful, the liquid crystal  
20 display 1134 displays the message "FAIL" and the operator  
is again connected to the consumer allowing the operator  
to speak to the consumer to provide additional assistance  
in the positioning of the telephone earpiece.

Alternatively, a live operator could be provided by  
25 the local cable company and the initial set-up information  
downloaded to the custom programmer 1100 by telephone  
line, through the existing cable of the cable system, or  
any other transmission means. If local cable companies  
supply the live operators, the only information they would  
30 need to gather from the consumer would be the VCR brand  
and model and the publication containing compressed codes  
that the consumer plans on using, because the local cable  
company would know the model and brand of cable box  
installed at the consumer's location and the necessary  
35 data regarding the local channel designations for that  
cable system.

1        FIGS. 43 and 44 are schematics of the circuitry  
needed to implement alternative embodiments of the custom  
programmer 1100. The circuit consists of microcomputer  
1150, oscillator 1152, liquid crystal display 1154, keypad  
5       1156, five way IR transmitters 1158 and red warning light  
emitting diode 1160. These components directly correspond  
to microcomputer 380, oscillator 382, liquid crystal  
display 384, keypad 386, five way IR transmitters 388 and  
red warning light emitting diode 332, respectively of  
10       instant programmer 300 and perform in the same manner. In  
both FIGS. 43 and 44, earpiece 1142 generates serial audio  
signals which are received by microphone 1162.

As shown in FIG. 43 the audio signals received by  
microphone 1162 are passed through amplifier 1164 and  
15       forwarded through a DTMF decoder circuit and into a serial  
port of microcomputer 1150. In the alternative circuit  
shown in FIG. 44, the audio signals received by microphone  
1162 are passed through amplifier 1166, through a high  
pass filter 1166 with a cutoff at approximately 1 - 5 kHz,  
20       and through a second amplifier 1170 to a serial port of  
microcomputer 1150.

Alternatively, a dual microphone system (not shown)  
may be employed to increase reliability, especially when  
the custom programmer 1100 is to be programmed in an  
25       environment with a high level of background noise that  
could interfere with the transmission of data through the  
single microphone acoustic means. In this system, one  
microphone would be placed near the telephone earpiece and  
the second microphone would be placed some distance away  
30       from the earpiece in order to pick up background noise.  
A audio signal cancellation circuit is then used to  
effectively "subtract" the background noise picked up by  
the second microphone from the audio data signals combined  
with the background noise that is picked up from the first  
35       microphone resulting in solely clean audio data signals.

Another preferred embodiment includes a separate  
initial set-up programmer 1200 as shown in FIGS. 45. The

1 initial set-up programmer 1200 serves the same basic  
function as the telephonic audio signal programming  
capability of custom programmer 1100, namely allowing the  
total set up of the instant programmer 300 or custom  
5 programmer 1100 with a minimum of effort on the part of  
the consumer. Normally, initial set-up programmers 1200  
would be maintained by sellers of either the instant  
programmer 300 or the custom programmer 1100. The initial  
set-up programmer could be programmed with the local  
10 channel tables for the cable systems and the television  
calendars that publish G-codes in the vicinity of the  
seller. When a customer purchases an instant programmer  
300 or custom programmer 1100, the seller can inquire  
where the customer lives and which television calendar the  
15 customer uses and use the initial set-up programmer 1200  
to download the appropriate local channel table for that  
customer. Further, the initial set-up programmer 1200 can  
also set the clock, VCR brand and model, and cable box  
brand and model for the customer's instant programmer 300  
20 or custom programmer 1100.

The initial set-up programmer 1200 includes a  
keyboard 1202, a display 1204, an enclosure 1206, and a  
lid 1208, with hinges 1209 at the top that allow the lid  
to open to reveal a depression 1210 for holding instant  
25 programmers 300 and custom programmers 1100 and two  
electrical contact pins 1212 as shown in FIG 46. The  
initial set-up programmer 1200 includes a modular phone  
jack 1230 and a serial port 1232 as shown in FIG. 47 for  
transferring data to and from computers, either directly  
30 or over telephone lines.

FIG. 48 shows two access holes 1213 in the bottom of  
the instant programmer 300 that allow access to two  
contact points on the to the circuit board (not shown)  
inside the instant programmer 300. FIG. 49 shows the  
35 initial set-up programmer 1200 with an instant programmer  
300 fit into the depression 1210 with the two contact pins  
1212 extending upwards through the access holes 1213 in

1 the bottom of the instant programmer 300. FIG. 50 shows  
the initial set-up programmer 1200 with a custom  
programmer 1100 fit into the depression 1210 with the two  
contact pins 1212 extending upwards through the access  
5 holes 1136 in the bottom of the instant programmer 300.

FIG. 51 is a schematic that shows circuitry included  
in the initial set-up programmer 1200. The initial set-up  
programmer includes a microcontroller (NEC  $\mu$ PD7530x) 1214,  
a liquid crystal display 1216, a keypad 1218, static  
10 random access memory (static RAM) 1220, computer port 1222  
and programming pins 1224. Local channel tables can be  
transferred from a computer to the initial set-up  
programmer 1200 and stored in static RAM 1220.

FIG. 52 is a schematic showing the data transfer  
15 connection between a personal computer 1226 and initial  
set-up programmer 1200. Local channel table data is  
output from personal computer 1226 through a serial RS-232  
port with +12 and -12 volt signals. The +12 and -12 volt  
signals are transformed to TTL compatible 0 and 5 volt  
20 signals by level shifter 1228 which are input into  
microcontroller 1214. Level shifter 1228 can be either  
external or internal to initial set-up programmer 1200.

Alternatively, local channel table data can be  
transferred to the initial set-up programmer 1200 by audio  
25 signals carried over telephone lines. Further, local  
channel tables may be entered into the initial set-up  
programmer through keyboard 1202 in the same manner used  
to program this information into either instant  
programmers 300 or custom programmers 1100.

30 Included in keyboard 1202 are "SEND CLK", "SEND CK",  
"SEND CAB" and "SEND VCR", which set the clock, download  
the local channel table, select the protocol for the cable  
box brand and model and select the protocol for the VCR  
brand and model, respectively when they are pressed. If  
35 the information is successfully transferred to the instant  
programmer 300 or custom programmer 1100 connected to the  
initial set-up programmer 1200, display 1204 displays the

1 message "Tr CK", otherwise the message "Tr Err" is  
displayed on display 1204.

5 Data is transferred to instant programmer 300 and  
custom programmer 1100 through the two contact pins 1212.  
The first of these pins is the ground pin. The second pin  
connects with test point 392 as shown in FIG. 22. Test  
point 392 is connected to both an interrupt pin and one  
input/output (I/O) pin of microcomputer 380. The two pins  
are tied together with an open collector method so that  
10 both input and output can be accomplished with one pin.  
The two contact pins 1212 connect to the same functional  
pins of the microcomputer 1150 of the custom programmer  
1100. Data is transferred serially through these pins at  
a 4800 baud rate using TTL voltage levels. The instant  
15 programmer 300 and custom programmer 1100 return a low  
pulse of a predetermined length to the initial set-up  
programmer 1200 when they have received all of transferred  
data.

20 The invention as shown in the preferred embodiments  
of the custom programmer 1100 and the initial set-up  
programmer 1200 can be readily included within  
televisions, video cassette recorders, cable boxes, or  
satellite receivers. It would not be complicated to embed  
either the custom programmer 1100 or the initial set-up  
25 programmer 1200 in televisions, video cassette recorders,  
cable boxes, and satellite receivers by adding suitable  
cabling or other transmission means between various video  
devices being used.

30 Another embodiment of the invention is the custom  
controller 1300 shown in FIGS. 53-58. The custom  
controller contains the same circuitry and performs the  
same functions as the custom programmer 1100, but also  
perform the functions of a complete universal remote  
control that can be set up automatically. The custom  
35 controller includes on its main control surface 1302 and  
its auxiliary control surface 1304, buttons that perform  
the same functions as buttons 1102-1112, 1156 of the

1 custom programmer, a display 1306 that performs the same  
functions as display 1134, 1154 and IR transmitters 1314  
which perform the same functions as IR transmitters 1131,  
1158. The custom controller can also be equipped with a  
5 lid (not shown) that covers hidden keys (not shown) used  
to set up the custom controller like lid 1114 on the  
custom programmer 1100 and lid 316 and keys 316-330 on the  
instant programmer 300. The keys under the lid could  
include SAVE, ENTER, CLOCK, CH, ADD TIME, VCR, CABLE and  
10 TEST keys like the instant programmer and the custom  
programmer.

The custom controller includes a microphone 1308,  
which performs the same functions as microphone 1140 of  
the custom programmer and is accessible through the  
15 microphone access hole 1309. Through the microphone, the  
custom controller is programmed with all of the set-up  
information needed to function as an instant or custom  
programmer (i.e., channel map, current time of day,  
model/brand of cable box and VCR). Alternatively, the  
20 custom controller can be programmed by the initial set-up  
programmer 1200 shown in FIGS. 45-47 and 49-51 in the  
identical manner described above in connection with these  
figures for the instant and custom programmers.  
Accordingly, the custom controller includes access holes  
25 1310 through which contact can be made with the contact  
pins 1212 of the set-up programmer 1200.

Custom controller 1300 also includes additional  
buttons on its control surfaces 1302 and 1304 that can  
30 be used to operate any home electronic device that can be  
controlled by an infrared remote control. These standard  
infrared remote controls work by transmitting different IR  
codes for each different function to be performed by the  
device being controlled. Each button of the custom  
controller triggers the transmission of an IR code that  
35 would ordinarily be transmitted by another remote control.  
The actual make up of these IR codes used to control the  
various home electronic equipment are described in more



1 detail in United States Patent No. 4,623,887 to Welles, II  
which is hereby incorporated by reference.

5 Most of the time, the custom controller will be used  
to control televisions, VCRs, cable boxes, satellite  
receivers and hi-fi audio equipment. It is noted that  
both the instant programmer 300 and the custom programmer  
1100 already functioned as universal remote controllers  
with respect to video recorders, cable boxes, televisions  
and satellite receivers as they can control diverse brands  
10 and models of these devices. However, the instant and  
custom programmers only use their universal remote  
features to change or select channels on cable boxes,  
video recorders, televisions and satellite receivers,  
begin and end recording by video recorders and turning the  
15 power on any of these devices on and off. Nonetheless,  
the schematic of the custom controller will be the same as  
the schematics of the custom programmer shown in FIGS. 43  
and 44 except that the custom controller includes a keypad  
(see 1156) with more buttons and the size requirements for  
20 the ROM and RAM in the microcomputer (see 1150) are  
greater than in the custom programmer. FIGS. 58 and 59  
show block diagram schematics for two alternate  
embodiments of the custom controller. It is noted these  
two schematics contain the same basic components, but the  
25 utilization and minimum size of the RAMs 1324 and 1330 and  
ROMs 1326, 1332 are different.

The custom controller's complete universal remote  
feature operates as follows. Each button on the keyboard  
1320, which is mounted on control surfaces 1302, 1304 of  
30 the custom controller, is hard wired with a button code or  
a memory address, which is generated each time the button  
is pressed. The microcomputer 1322 receives the code or  
address generated by the pressed button and, if the button  
generates a code, consults a look-up table to retrieve an  
35 address for the button code. This look up table, as well  
as the instructions that control the operation of the  
microprocessor are stored in ROM 1326 and 1332.

1           In the embodiment of FIG. 58, the microprocessor  
retrieves an IR code from RAM 1324 at the address derived  
from the pressed button. In this embodiment, the minimum  
size for the ROM is very small as the ROM only needs to  
5       store the button code look up table and microprocessor  
instructions. However, the size of the RAM needs to be  
large enough to store an IR code for each button on the  
keyboard.

10           In the embodiment of FIG. 59, the microprocessor  
consults a look-up table in RAM 1330 which contains  
address to ROM 1332, which contains the actual IR codes.  
The ROM address is retrieved from RAM at the address  
derived from the pressed button on keyboard 1320. The IR  
code is then retrieved from ROM at the address retrieved  
15       from RAM. This embodiment allows the ROM to be  
preprogrammed with the IR codes for a large number of home  
electronic devices. This increases the minimum size of  
the ROM substantially, but reduces the minimum size of the  
RAM because ROM addresses are generally shorter than IR  
20       codes.

          In both the embodiments of FIG. 58 and 59, the IR  
code retrieved from either ROM or RAM is sent by the  
microprocessor to IR transmitters 1328 and is transmitted.

25           Before the custom controller can be used as a  
complete universal remote control, it must be programmed  
with the IR codes for the functions and the brand and  
models of home electronic equipment it is going to  
control. Traditionally this has been done in two  
different ways. First, the custom controller can "learn"  
30       the IR codes for the products that it is to control from  
the remote controls that come with each product. The  
custom controller would then also include an IR receiver  
(not shown) that would receive IR codes from other remote  
controls and store these codes and which button on the  
35       custom controller each code is associated with into RAM.  
This type of "learning" controller usually employs the  
schematic of FIG. 58. The second traditional programming

1 method involves providing a ROM that contains the IR codes  
for most functions of most brands and models of home  
electronic equipment. The user then enters into the  
custom controller what brand/model of each type of home  
5 electronic device that the user plans to use the custom  
controller with. In this method, for each brand and model  
of home electronic equipment, the custom controller will  
also include in ROM the associations between the IR codes  
for the equipment and the keys on the custom controller  
10 that will trigger the sending of the IR codes. A  
controller utilizing this second programming method  
usually employs the schematic of FIG. 59.

In an alternate embodiment, the custom controller can  
be programmed by either of both of these methods. IR  
15 codes that are "learned" from other remote controllers are  
store in RAM 1324 shown in FIG. 58. Alternatively, ROM  
1332 shown in FIG. 1332 includes IR codes for most VCRs,  
cable boxes, satellite receivers, televisions and stereo  
components and the ability to program which brand/model of  
20 these device he or she is using. In yet another  
embodiment, the embodiments shown in FIGS. 58 and 59 can  
be combined by including a flag bit in the data stored in  
RAM 1324 or 1330. If the flag bit is set, the rest of the  
data at that address is a ROM address which points to the  
25 location of the IR code in ROM 1332. If the flag bit is  
not set, the rest of the data at that address contains  
actual IR code data.

In the preferred embodiment of FIGS. 53-60, though  
IR codes are programmed into the memory of the custo  
30 controller through the microphone 1308 that is used for  
the set up of the channel map, cable box and VCR  
brand/model and the current time of day. Using the  
process shown in FIG. 60, a process similar to that  
described above in connection with the custom programmer  
35 1100, in block 1340, the user calls either a special phone  
number which could be a toll-free 800 number, a  
pay-per-minute 900 number, or a standard telephone number

1 with standard toll charges applying. In block 1342, the  
consumer speaks on the telephone to a customer service  
representative (representative) located at a remote site  
who orally inquires from the consumer the information  
5 regarding the brand and model of each home electronic  
device with which the consumer wants to use custom  
controller. In blocks 1346 and 1348, the consumer also  
has the opportunity to tell the representative which  
functions each button of the control surfaces 1302 and  
10 1304 is to perform. In block 1350, the representative  
enters this information into a computer at the remote  
site. If the consumer does not have preferences regarding  
which button of the custom controller is used to perform  
which functions, in block 1352, the representative does  
15 not enter any preferences into the computer and the  
computer relies on default associations between the  
buttons and functions that are previously stored in the  
computer.

Once this information has been entered into the  
20 computer, in block 1354 the computer programs the custom  
programmer in at least two different ways, depending on  
whether the embodiment of FIG. 58 or 59 is used. If the  
embodiment of FIG. 58 is used, the computer downloads,  
through microphone assembly 1334 in either manner  
25 described above in connection with the custom programmer  
and shown in FIGS. 43 and 44, all of the necessary IR  
codes into RAM 1324 at the addresses associated with the  
buttons on the keyboard 1320 according to the consumer's  
expressed wishes. If this method is used, no IR codes  
30 need be stored in the ROM of the custom controller when it  
is manufactured.

If the embodiment of FIG. 59 is used, the ROM 1332  
installed into the custom controller at manufacture is  
programmed with the IR codes of many different brands,  
35 models and types of home electronic devices. In this  
case, the computer downloads, through microphone assembly  
1334, the addresses of the ROM for all of the necessary IR

1 codes into RAM 1330 instead of downloading the IR codes  
themselves.

5 In an alternative embodiment the ROM 1332 contains  
default associations between IR codes and buttons of the  
custom controller, so that these associations need not be  
downloaded unless the consumer has requested associations  
between buttons and IR codes that are different from the  
default associations. This method reduces the amount of  
10 data that needs to be sent over the telephone lines from  
the remote site to the custom controller, but can increase  
the size and cost of the ROM installed in the custom  
controller. In the rare case where the IR codes for the  
device that the consumer wants to control are not included  
15 in the ROM, the computer would just download the IR codes  
themselves for that device as in the first programming  
method described above with reference to FIG. 58.

It is noted above that in either of the embodiments  
shown in FIGS. 58 and 59, the microphone and decoding  
assemblies from either FIG. 43 or FIG. 44 may be used.  
20 Preferably, the microphone and decoding assembly in FIG.  
44 is used as it is less expensive than the assembly in  
FIG. 43 that uses a DTMF decoder 1166. The system shown  
in FIG. 44 utilizes just two single frequency signals  
rather than many dual frequency signals as in a DTMF  
25 system. The first signal, a tone of approximately 3000  
Hz, is used to signify a binary "one" and the second  
signal, a tone of approximately 500 Hz, is used to signify  
"zero." Since a 500 Hz signal is being used in this  
embodiment, the bandwidth of the 1000 - 5000 Hz high pass  
30 filter 1168 from FIG. 44 will have to be broadened to  
include 500 Hz when included in the microphone and decoder  
assembly 1334.

A series of these two tones are transmitted over the  
telephone line, representing a binary series. A short  
35 period of no signal is included between each tone in the  
series of tones so that two consecutive 500 Hz or two  
consecutive 3000 Hz signals are interpreted as two

1 sequential signals and not one long signal. In an  
alternative embodiment, the series of signal tones are  
sent at a predetermined clock speed.

5 A decoder (not shown) is included between the  
microphone assembly 1334 and the microprocessor 1322 that  
converts the 3000 Hz signals to high electrical signals  
and converts the 500 Hz signals to low electrical signals  
that are sent to a serial input into the microprocessor.  
A clock signal is simultaneously sent to the  
10 microprocessor with each high or low signal.

Alternatively, the initial set-up programmer 1200  
could be used to perform the IR code programming of the  
custom controller 1300 instead of using the  
microphone/telephone interface.

15 The custom controller has several additional  
features. First, the rear surface 1312 of the custom  
controller is large enough so that custom controller can  
be set on the rear surface as shown in FIG. 61 and resist  
tipping over. The advantage of being able to stand the  
20 custom controller in this upright position is that IR  
transmitters 1314 are then at a substantial height above  
the surface on which the custom controller is set. This  
lessens the probability that pillows, newspapers,  
magazines or other debris will be inadvertently placed on  
25 top of the custom controller as it will be difficult for  
debris to balance on the top of the custom controller when  
while in the upright position. Further, stacks of  
pillows, magazines and other debris placed next to the  
custom controller must be rather high before they will  
30 block the IR transmissions of the custom controller. This  
feature is extremely important because, unlike the instant  
programmer which can have a permanent holder next to the  
cable box and VCR, away from magazines and pillows, the  
custom controller, having full universal remote  
35 capabilities, is designed to be used some distance away  
from the video equipment. Yet, to function properly as an  
automatic video recorder controller, the IR transmitters

1 of the custom controller need to have a direct line of  
sight to the IR receivers of the video equipment to be  
controlled.

5 The degree of enlargement of the rear surface 1312  
needs to be enough so that the custom controller is stable  
and resistant to being tipped over when it is put in the  
upright position shown in FIG. 58. Determining an  
acceptable size of rear portion is based on several  
factors. First, it usually desirable for the length and  
10 the width of the rear surface to be approximately equal.  
If the length is significantly greater than the width (as  
is the case with traditional prior art universal remote  
controls), the controller can be easily tipped over along  
the axes that span the width of the rear surface. Next,  
15 the proportion of the height of the controller to the  
length and width of the rear surface cannot be too great.  
A ratio of the length of the rear face to the height of  
the controller and of the width of the rear face to the  
height of the controller of approximately 3 to 1 or less  
20 is usually sufficient. However, this ratio depends on the  
uniformity of the density of the custom controller and  
thus the center of gravity. If the upper portions of the  
custom controller (when it is in the upright position) are  
more dense than the lower portions, the center of gravity  
25 will be high and the ratio of the width and length of the  
rear surface will need to be reduced. On the other hand,  
if the lower portions are more dense, the center of  
gravity will be lower and the ratio can be safely  
increased. One way the center of gravity is lowered is  
30 the custom controller is by placing the batteries 1316,  
which are comparatively very dense, very near the rear  
surface.

Another factor in the stability of the custom  
controller in the lateral location of the custom  
35 controller's center of gravity. The closer the center of  
gravity is to being directly above the center of the rear  
surface when the custom controller is in the upright

1 position, the more stable the custom controller will be.  
It is noted that the upper portion of embodiment of the  
custom controller shown in FIGS. 53-58 is off center.  
This moves the center of gravity away from the center of  
5 rear surface slightly, but adds to the aesthetic  
appearance of the custom controller.

The shape of the rear surface is not particularly  
relevant, but rather the shortest distance across the rear  
surface. On the other hand, the shape of the back surface  
10 of the custom controller is significant. Preferably, the  
back surface is semicircular or substantially  
semicircular. The closer the back surface is to a  
semicylindrical shape, the more comfortable the custom  
controller is for a consumer to hold, as the cylindrical  
15 shape fits better into human hands.

Another feature of the custom controller is its two  
control surfaces 1302 and 1304. Auxiliary control surface  
1304 is designed to include buttons that will be used most  
often when the custom controller is in its upright  
20 position, such as volume up and down controls. The angle  
between the rear surface and the auxiliary control surface  
is less than or equal to 45°. Keeping the angle less than  
or equal to 45° directs at least half of the force needed  
to press button on the auxiliary control surface downwards  
25 into the table or other surface the custom controller is  
resting on instead of sideways, which would tend to topple  
the custom controller when it is in the upright position.

Two alternative embodiments of the custom controller  
1300 are shown in FIGS. 65-70 and FIGS. 71-76. These  
30 controllers include control faces that are at angles from  
the rear face of less than or equal to 45°, substantially  
circular bottom faces and rear faces that are larger  
relative to prior art remote controls.

Yet another feature of the custom controller are one  
35 touch channel tuning buttons. These buttons would be  
assigned to a specific television or cable channel such as  
HBO, ESPN, CNN or MTV. For example, if a button is



1 assigned to CNN, when the CNN button is pressed, the  
custom controller transmits IR codes to change the channel  
on a television, VCR, cable box or satellite receiver to  
the channel number on which CNN is broadcast. When the  
5 consumer sets up the custom controller, he or she tells  
the representative what channels he or she watches the  
most and the representative directs the computer to have  
selected keys on the custom controller be programmed to  
tune these channels. The consumer tells the  
10 representative which keys on the custom controller he or  
she wishes to tune which channels or the representative  
can select the keys. After the keys and channels have  
been selected, the consumer then writes the channel names  
next to the keys that tune them or labels with different  
15 channel names can be supplied which are then applied to  
the custom controller next to the appropriate buttons.  
These one touch tuning buttons are particularly well  
suited to being programmed as buttons on the auxiliary  
control surface, so that the consumer can operate these  
20 buttons without having to pick up the custom controller.

It is thought that the universal remote that includes  
apparatus and method using compressed codes for television  
program record scheduling of the present invention and  
many of its attendant advantages will be understood from  
25 the foregoing description and it will be apparent that  
various changes may be made in the form, construction and  
arrangement of the parts thereof without departing from  
the spirit and scope of the invention or sacrificing all  
of its material advantages, the form hereinbefore  
30 described being merely a preferred or exemplary embodiment  
thereof.

1     WHAT IS CLAIMED IS:

5             1. A remote control for transmitting control codes  
for control of home electronic devices and for using  
compressed codes for automatically recording video  
signals, by a video recorder, under control of sets of  
channel, date, time-of-day and length commands, the remote  
control comprising:

10                 means for entering compressed codes, each  
representative of, and compressed in length from, a set of  
individual channel, date, time-of-day and length commands;

               means for decoding said compressed codes into  
sets of individual channel, date, time-of-day and length  
commands;

15                 a keypad comprising a plurality of buttons;

               means for storing control codes for control of  
home electronic devices and for storing associations  
between said buttons and said control codes

20                 means for retrieving from said storing means,  
when one of said buttons is activated, any such control  
codes associated with such activated button;

25                 a transmitter for transmitting retrieved control  
codes and for transmitting record on, record off and  
channel select control codes according to said individual  
channel, date, time-of-day and length commands; and

               means for receiving said control codes and said  
associations between said control codes and said buttons  
for storage in said means for storing.

30             2. The remote control of claim 1 wherein said means  
for receiving are coupled to a computer.

35             3. The remote control of claim 1 wherein said means  
for receiving are coupled to a computer through a  
telephone line.

           4. The remote control of claim 1:

1            wherein said means for storing further comprise  
means for storing at least one local channel number for at  
least one channel number in said channel command; and

5            wherein said means for receiving further  
comprise means for receiving local channel numbers  
corresponding to channels numbers in said channel commands  
and the correlation of said local channel numbers to said  
channel numbers in said channel commands for storage in  
said means for storing; and

10           wherein said transmitter transmits said channel  
commands according to local channel numbers stored in said  
storing means to said means for channel selection  
according to said individual date, time-of-day and channel  
commands.

15           5. The remote control of claim 4 wherein said means  
for receiving are coupled to a computer.

20           6. The remote control of claim 4 wherein said means  
for receiving are coupled to a computer through a  
telephone line.

            7. The remote control of claim 1 further  
comprising:

25           a clock;  
            means for setting said clock according to  
signals representative of time;

            wherein said means for receiving further  
comprise means for receiving said signals representative  
30           of time.

            8. The remote control of claim 7 wherein said means  
for receiving are coupled to a computer.

35           9. The remote control of claim 7 wherein said means  
for receiving are coupled to a computer through a  
telephone line.

1

10. A remote control comprising:

a rear face;

a bottom face connected to said rear face;

5

a top face connected to said rear face;

at least one transmitter located at the end of  
the top face opposite said connection to said rear face;

10

wherein the length of the top face, measured  
from said connection to said rear face to the opposite end  
of said top face is greater than the minimum of the length  
and width of the rear face.

15

11. The remote control of claim 10 wherein said top  
face comprises a substantially flat control surface.  
including buttons, that is at an angle of less than  
forty-five degrees from said rear face.

20

13. The remote control of claim 10 further  
comprising batteries, fixed in a position substantially  
adjacent to said rear face.

25

12. A method of programming a universal remote  
control with control codes for controlling a home  
electronic device comprising:

entering information sufficient to identify the  
control codes needed to control said home electronic  
device into a computer;

30

downloading said control codes through an audio  
connection from said computer to said universal remote  
control.

35

1                   **APPARATUS AND METHOD USING COMPRESSED CODES  
FOR TELEVISION PROGRAM RECORD SCHEDULING**

**Abstract of the Disclosure**

5                   Encoded video recorder/player timer preprogramming  
information listed in a television calendar allows a timer  
preprogramming feature on a video cassette recorder VCR to  
be programmed using a compressed code of as few as 1 to 8  
10                  digits, which are decoded by a decoder built into a remote  
control, video cassette recorder, television or other  
video device to convert the compressed code into channel,  
date, time and length information. The channel, date,  
time and length information is used to select channels,  
start recording, and stop recording at the appropriate  
15                  time. A local channel map is stored so that the channel  
information from the compressed codes can be utilized to  
tune the correct channel even though channel numbers in  
different localities may be different. The remote may be  
a universal remote control capable of selecting between  
20                  various stored infrared code protocols for commanding  
different brands and model of video devices. The remote  
may also be a complete universal remote control that  
transmits infrared codes to a variety of home electronic  
devices upon the user pressing buttons associated with the  
25                  functions associated with the infrared codes. The  
programming of local channel map data, infrared codes and  
protocols and their association with specific buttons on  
the remote control can be accomplished by the remot  
30                  control's keyboard or by an external device, including  
external devices that accomplish the programming by  
transmissions over telephone lines.

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FIG. 1

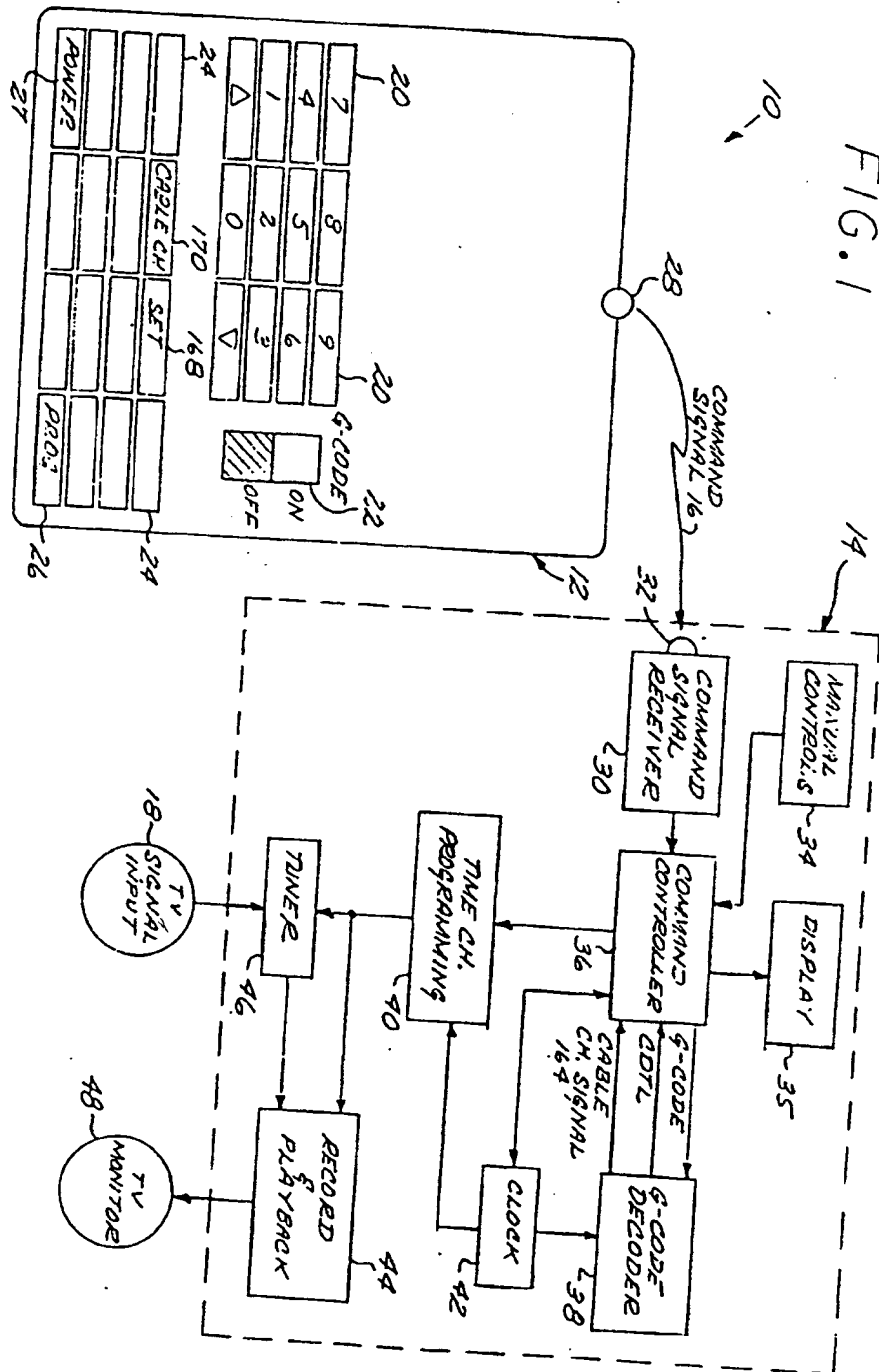


FIG. 2

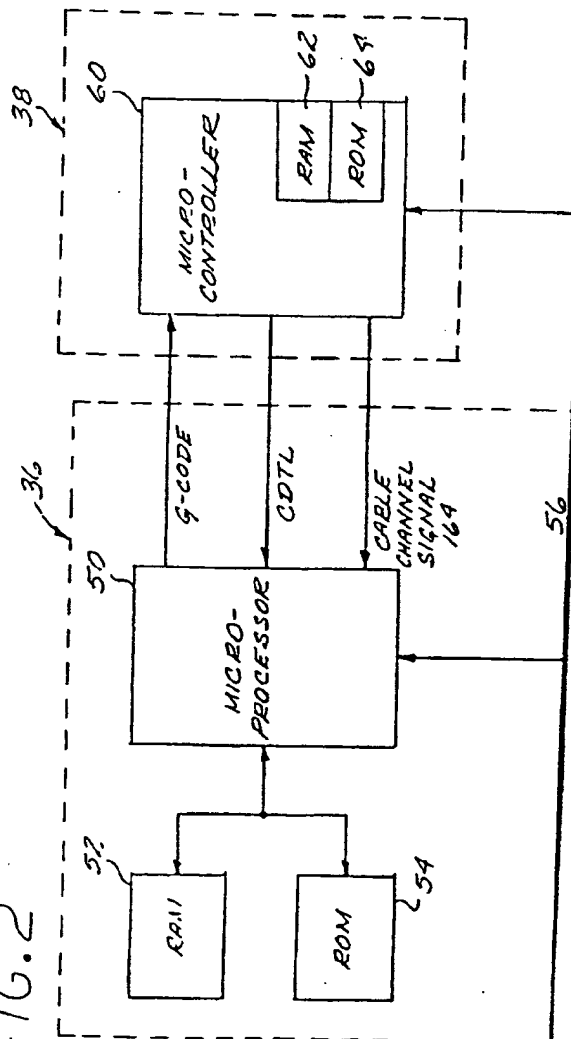
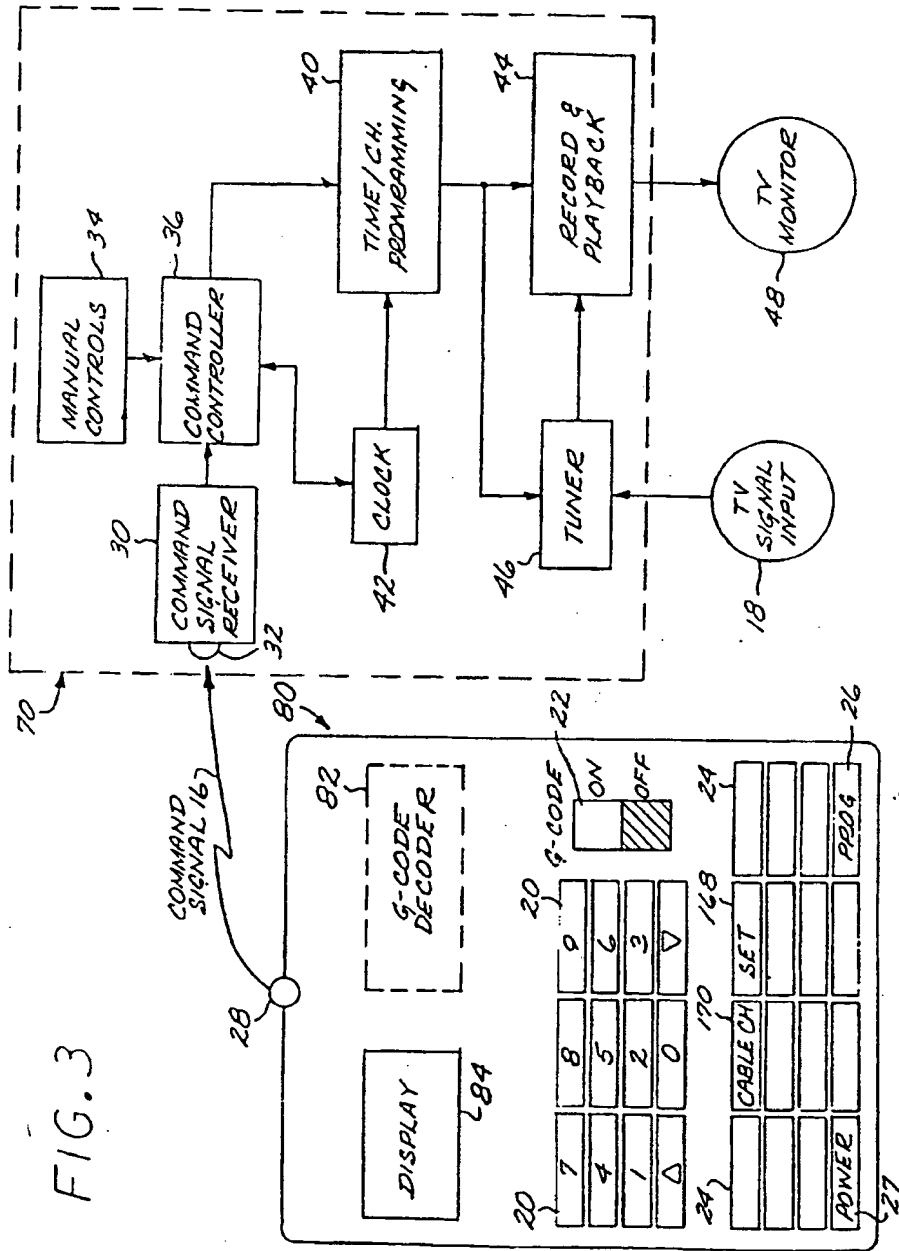
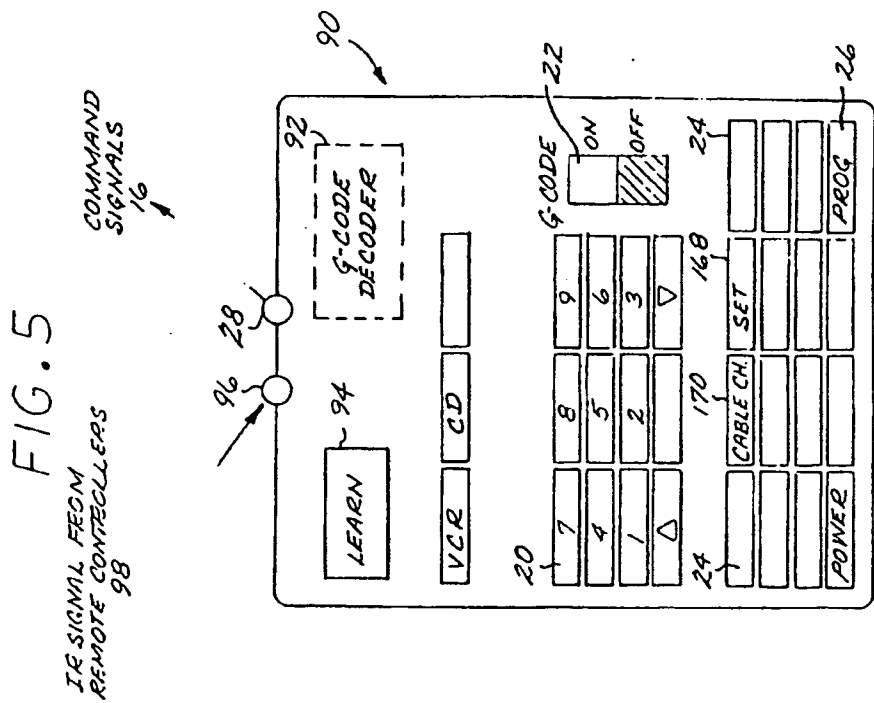
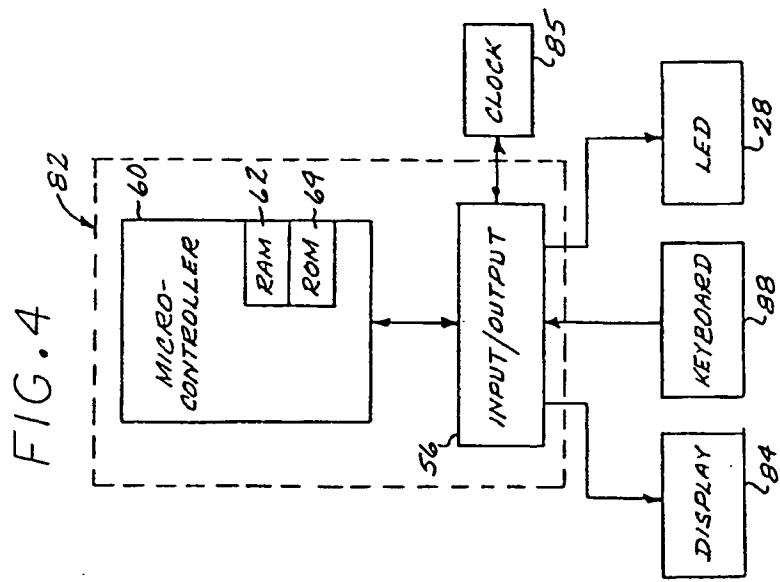


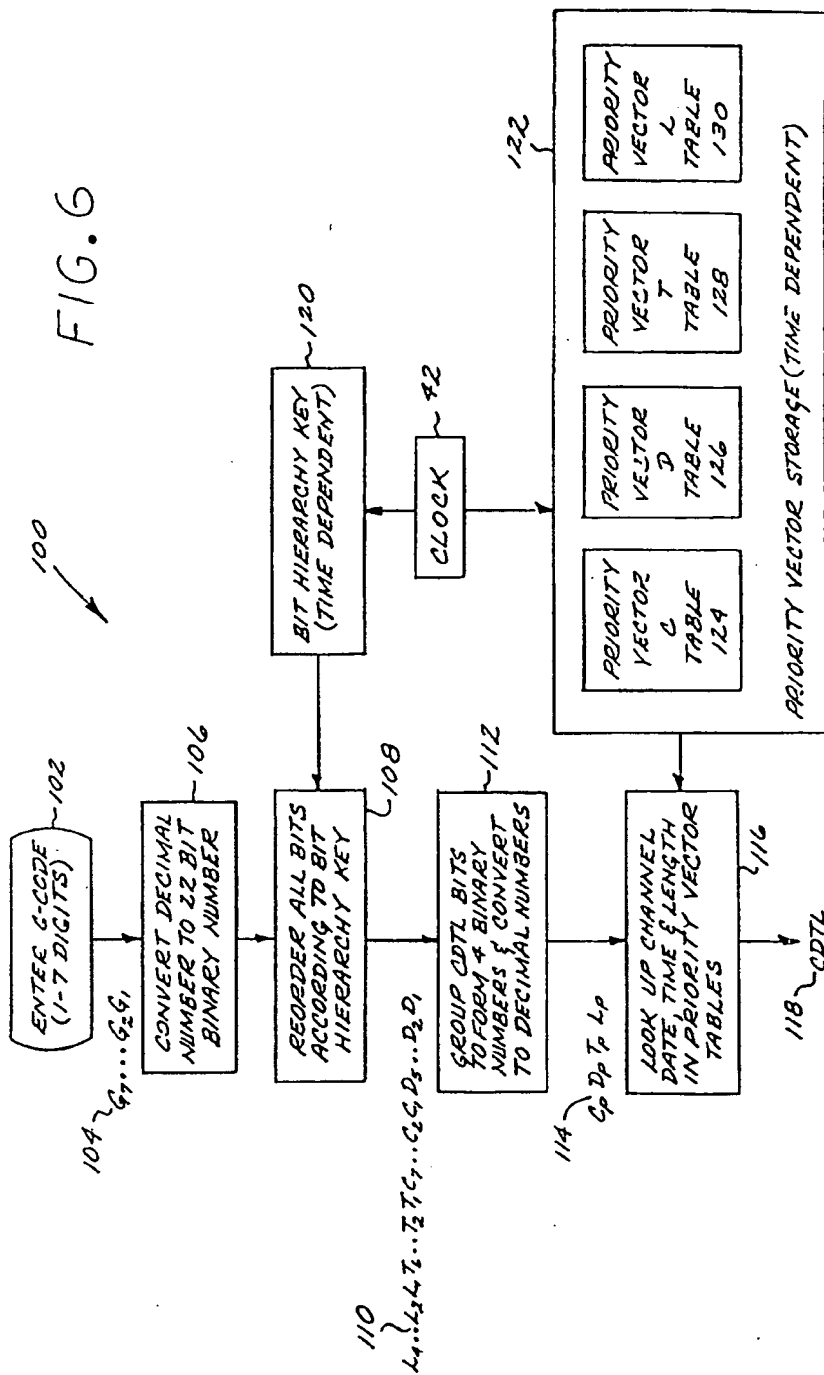
FIG. 3







100



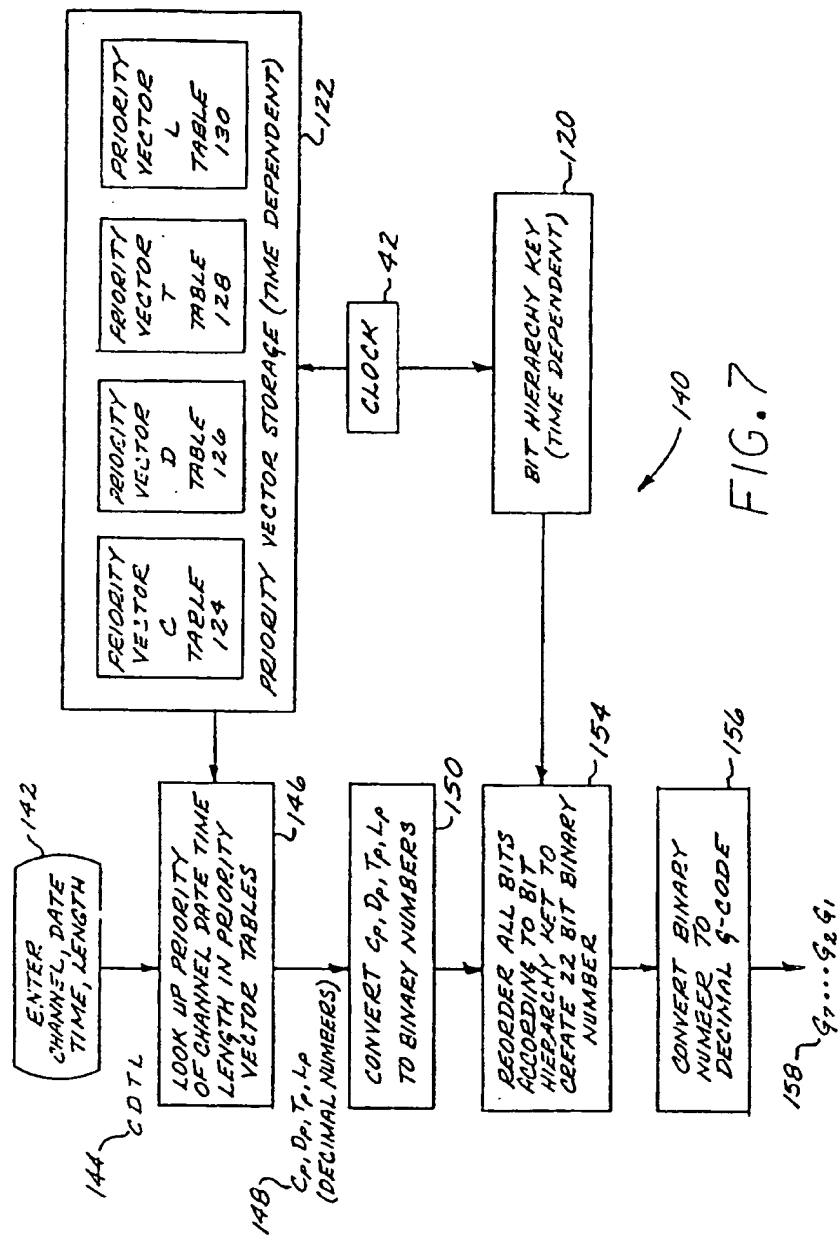


FIG. 7

THURSDAY 204

FEBRUARY 9, 1989 / 202

203 [8] SPORTS RETROSPECTIVE; 60 MIN. [68713] 200  
6 PM [24] NATURE SCENE [5321]  
206 A VISIT TO THE COLORADO NATIONAL MONUMENT  
210 NEAR GRAND JUNCTION, WHERE WILDFLOWERS,  
INSECT AND BIRDS ARE OBSERVED  
[34] [52] NOTICIAS [62921] [496649]  
[40] DWIGHT THOMPSON -- RELIGION; [68553]  
[50] HUMANITIES THROUGH THE ARTS [493065]  
[56] BEVERLY HILLBILLIES -- COMEDY [496777]

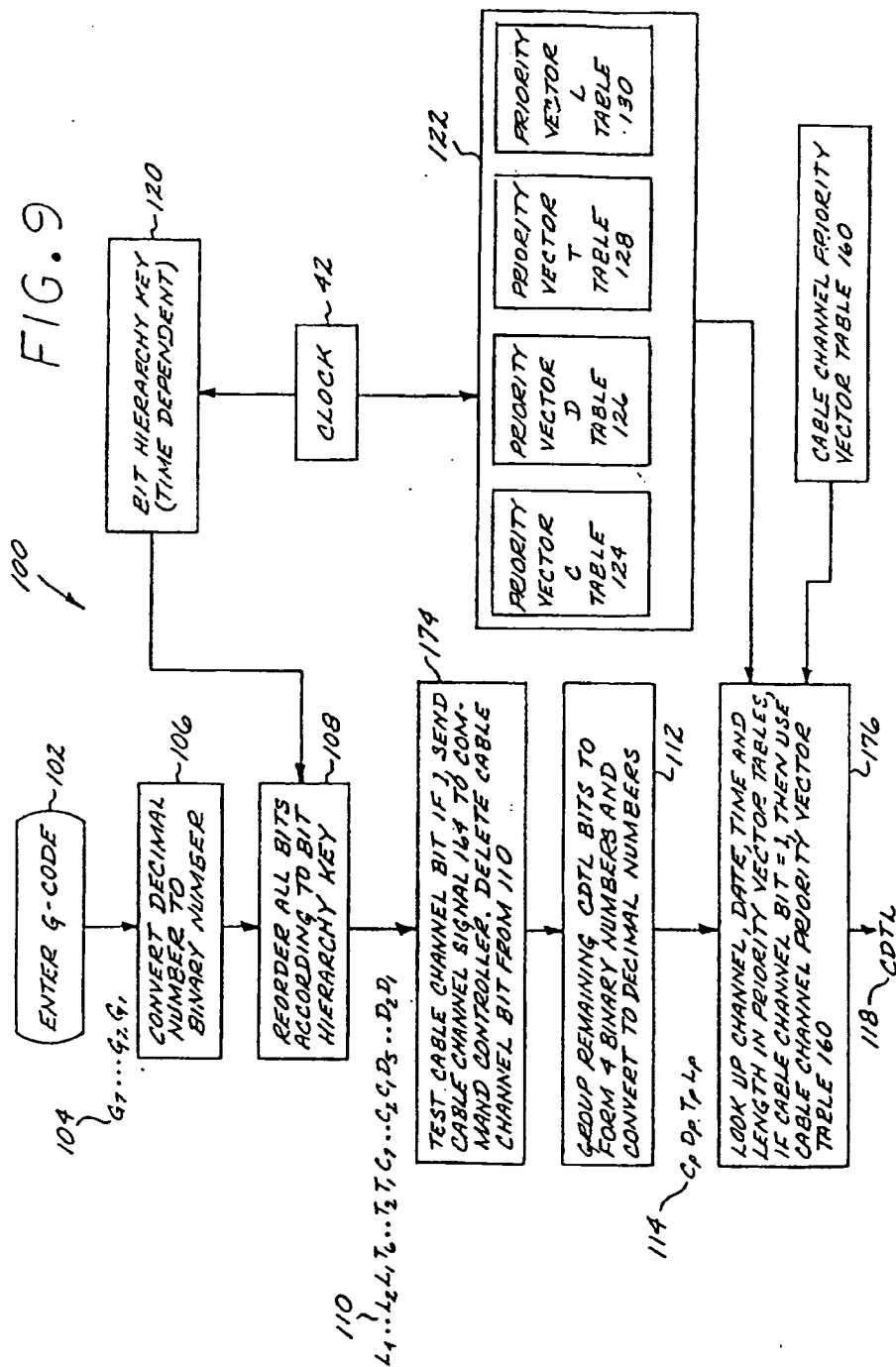
FRIDAY 204

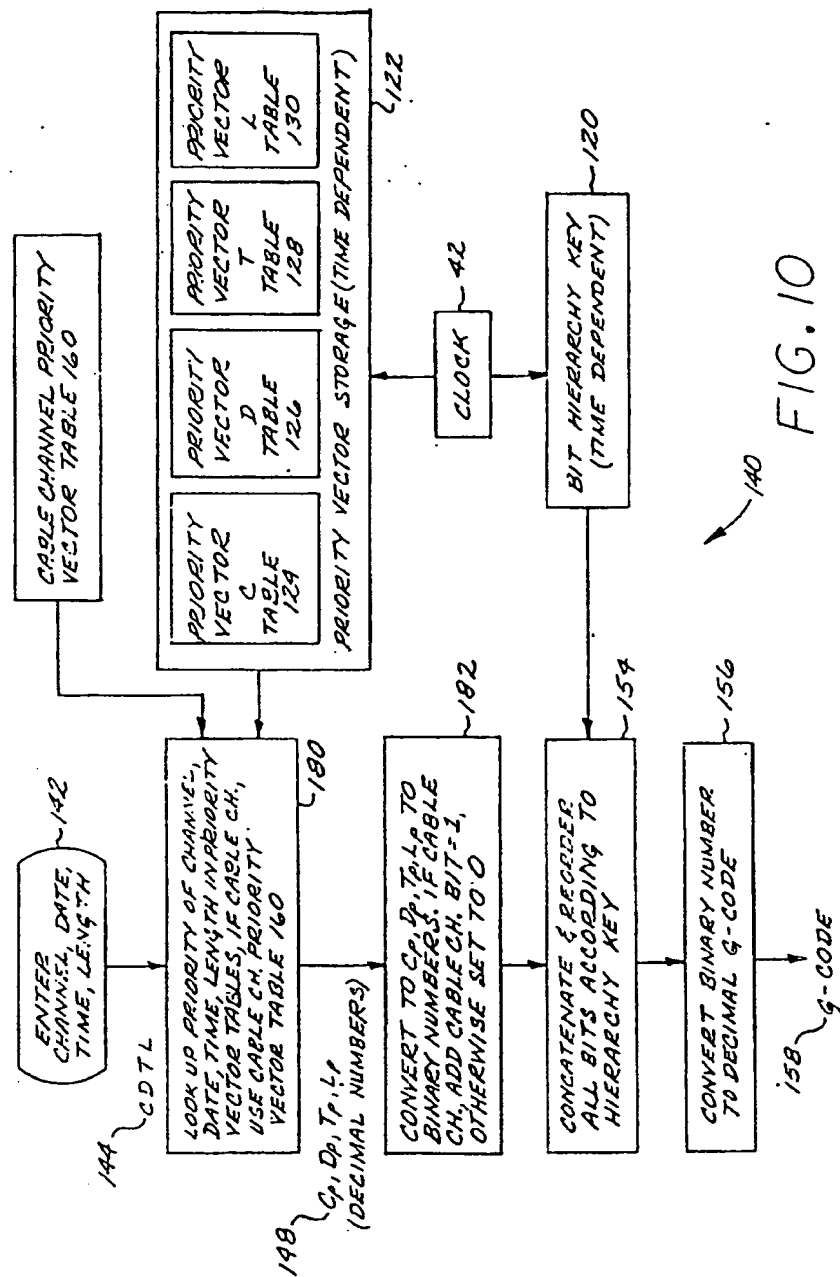
FEBRUARY 10, 1989 / 202

[68] DIS MOVIE -- DRAMA; 70 MIN. (23627113)  
6:30 [11] FAMILY TIES (CC) -- COMEDY [15657]  
206 MALLORY'S REUNION WITH HER COLLEGE BOY FRIEND 200  
(JOHN DUKAKIS) HAS HER WORRIED THAT SHE MAY  
208 NOT BE AS INTERESTING TO HIM AS SHE ONCE WAS.  
[56] HOGAN'S HEROES - COMEDY [510857]  
188 CAPTAINS MASQUERADE AS A TRAITOR MAY BE  
KAPUT: A LOVELY FRIGOLEN IS TRYING TO POISON HIM  
[214] NIK DOUBLE DARE - GAME (29225) 212  
[217] TNN VIDEO COUNTRY (29129)  
[27] USA CARTOON EXPRESS (23561)  
7 PM [5] CHARLES IN CHARGE (CC) - COMEDY [1065]  
206 WHILE PLAYING A PIZZA-PALOE PARTY, CHARLES  
ALIENATES THE POWELL CHILDREN BY DISMISSING  
THEIR SUGGESTIONS ABOUT ORGANIZING THE EVENT.

FIG. 8

FIG. 9





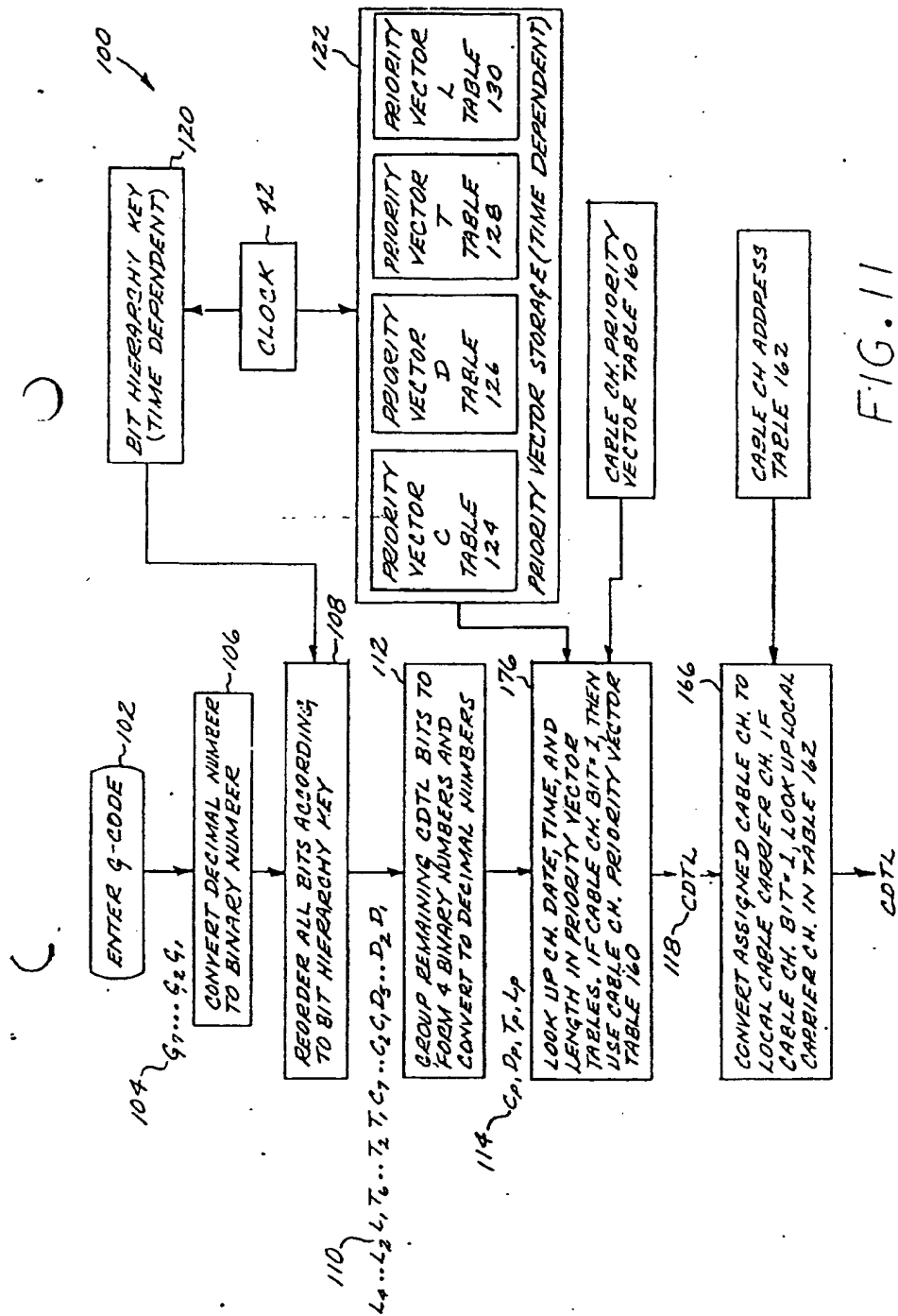


FIG. 11

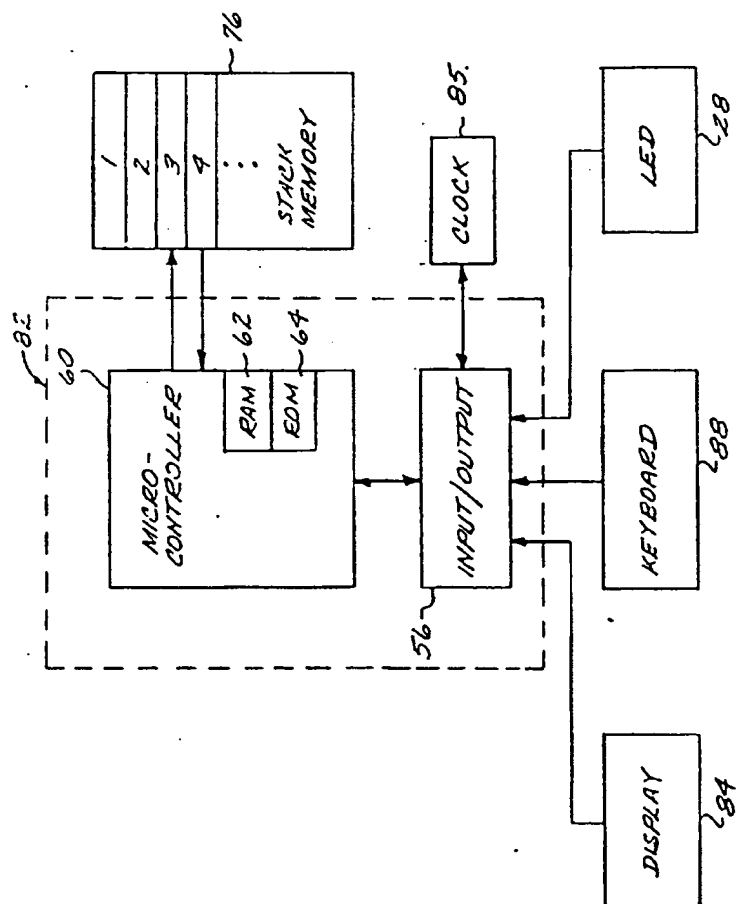


FIG. 12



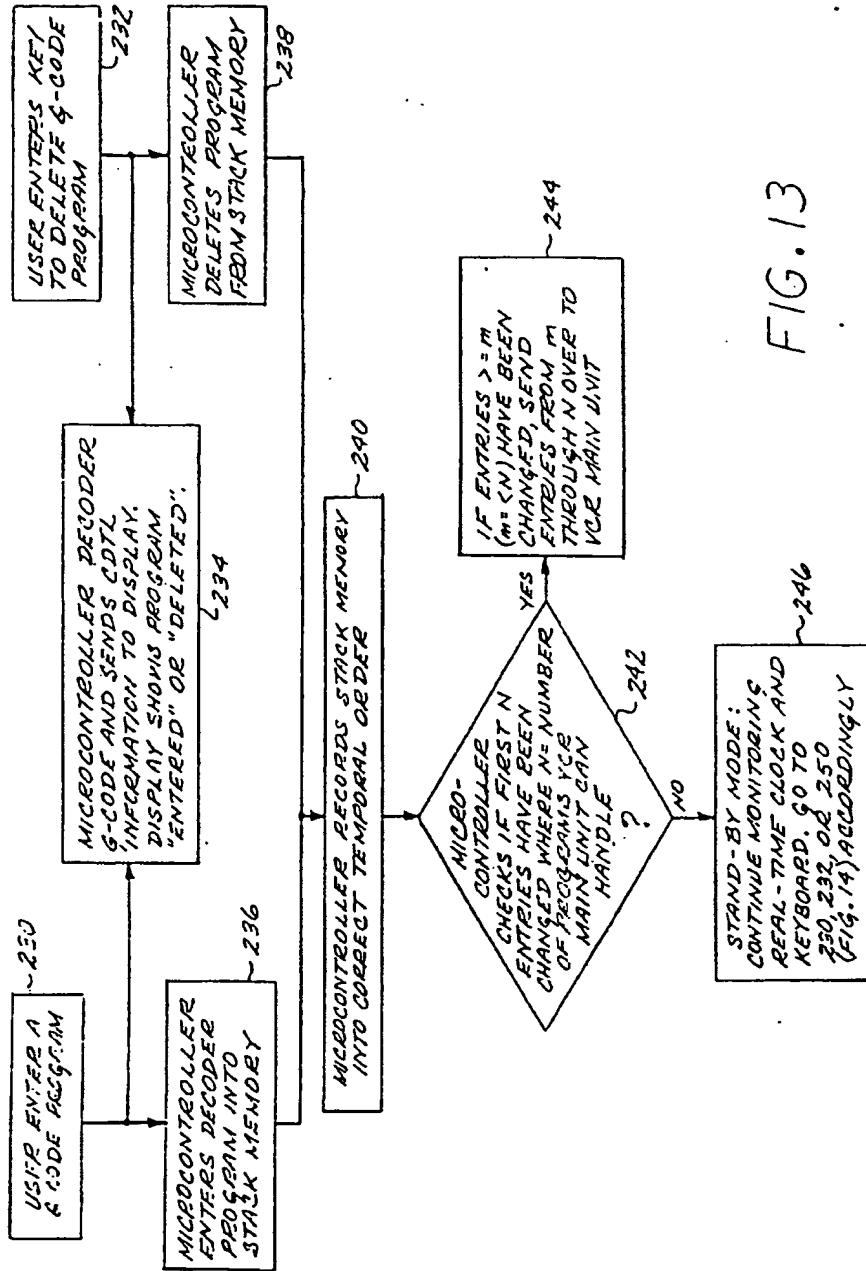


FIG. 13

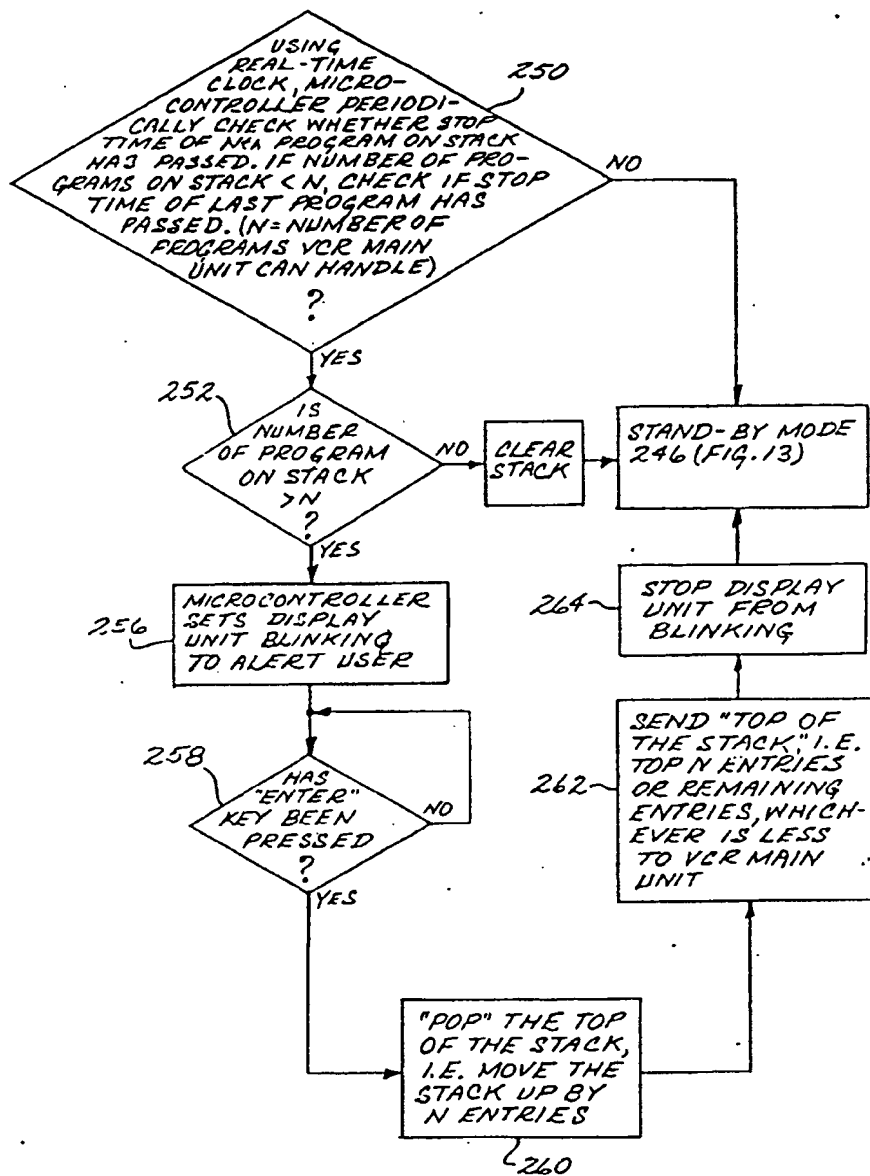


FIG. 14

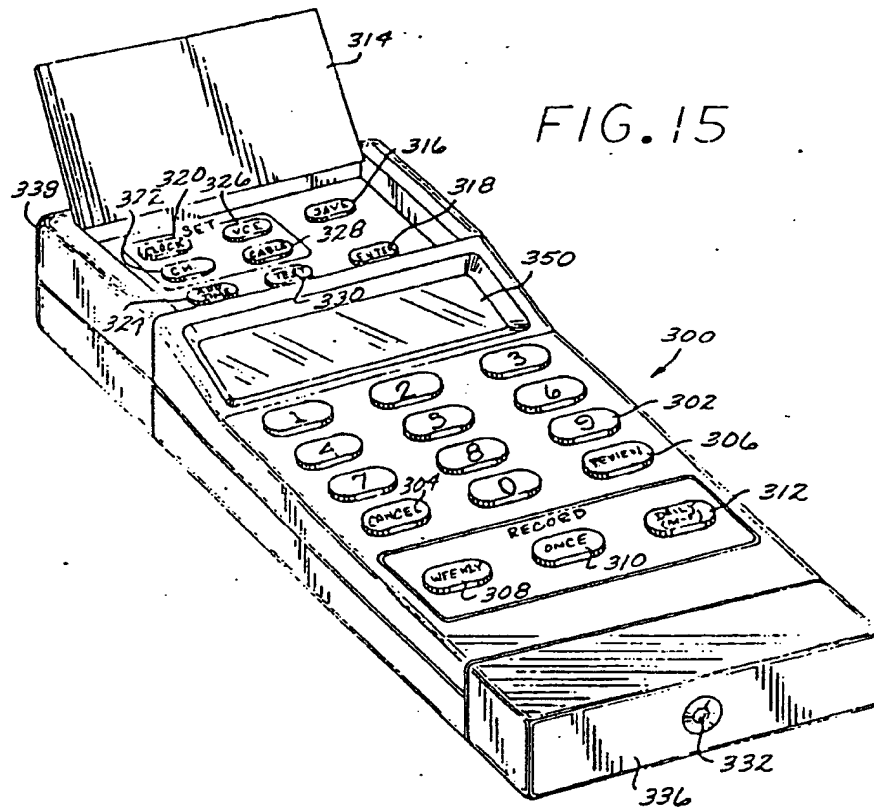
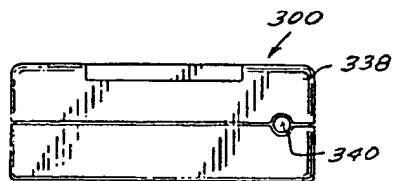
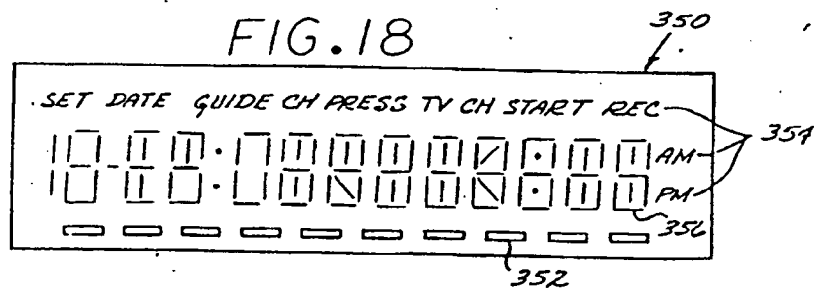
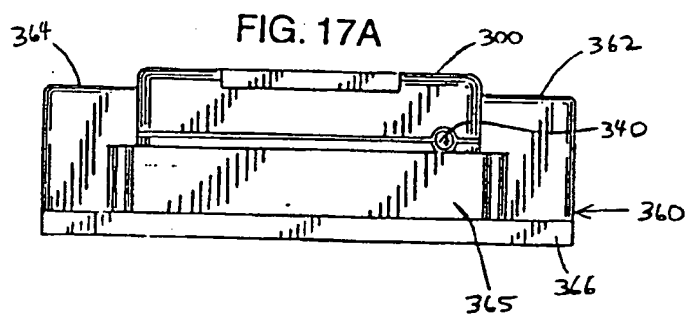
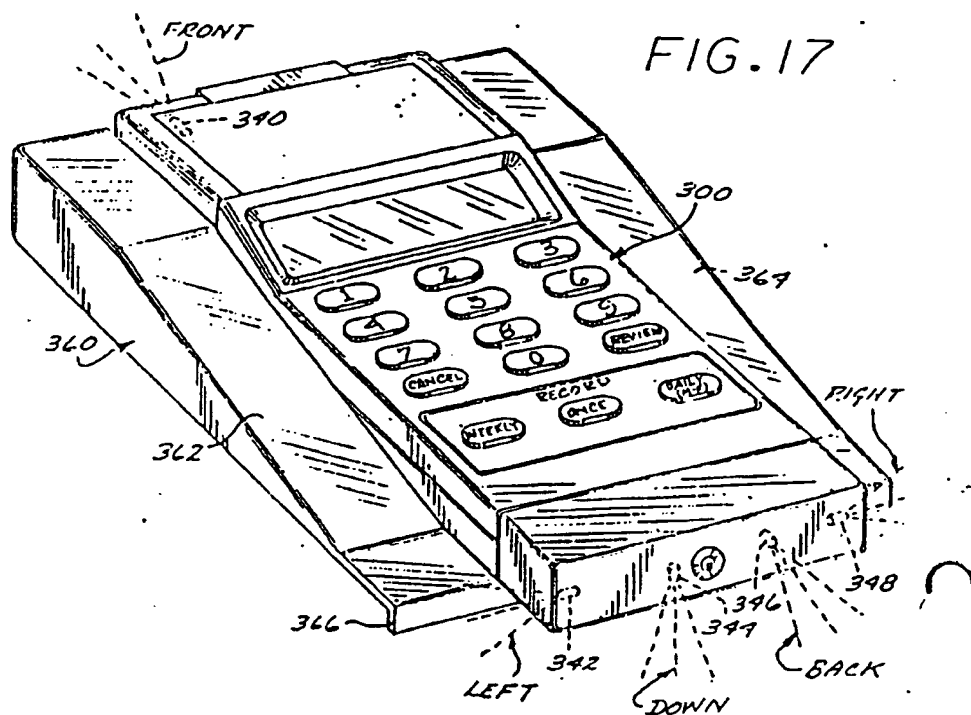


FIG. 16





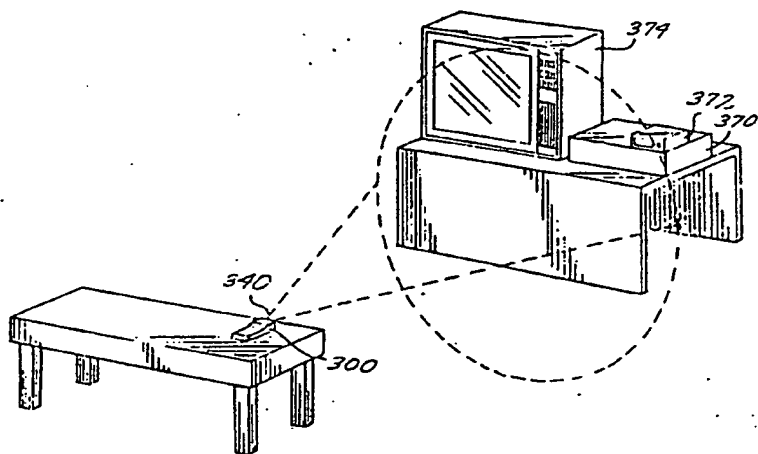


FIG. 19

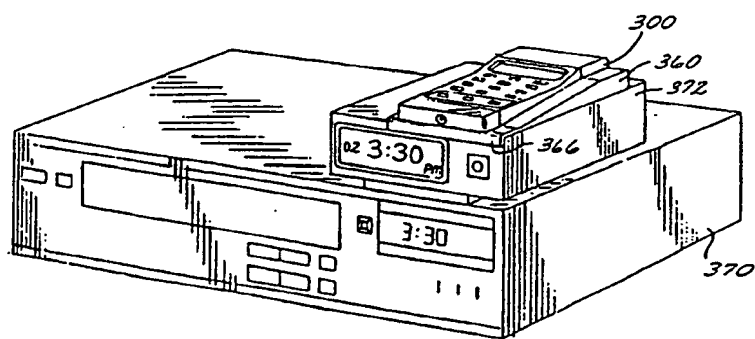


FIG. 20

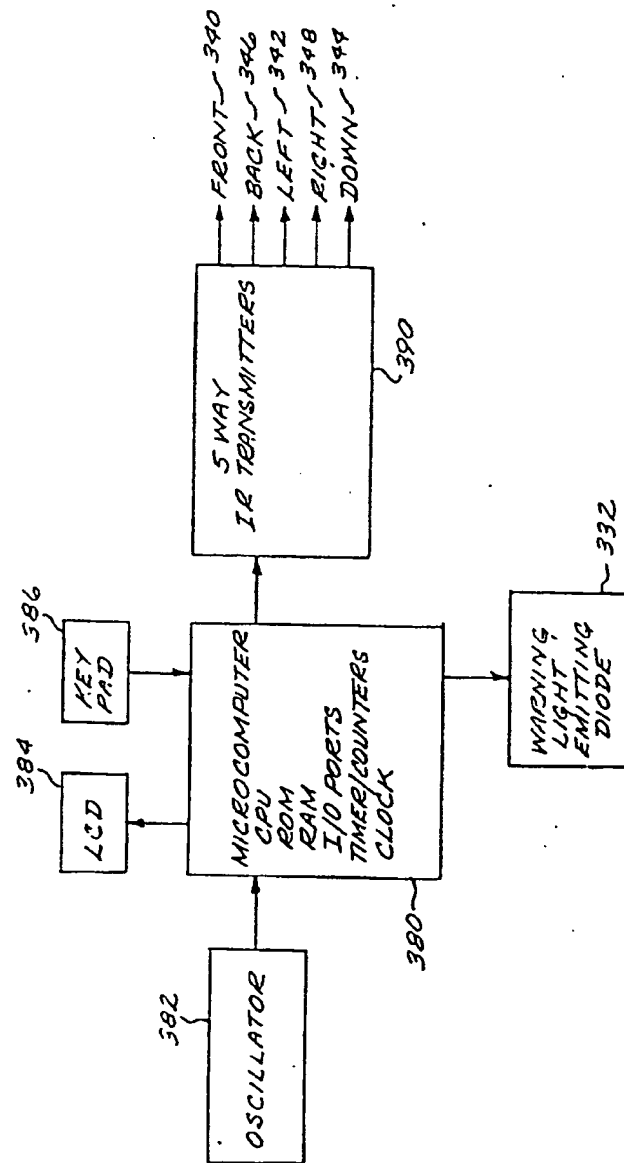


FIG. 21

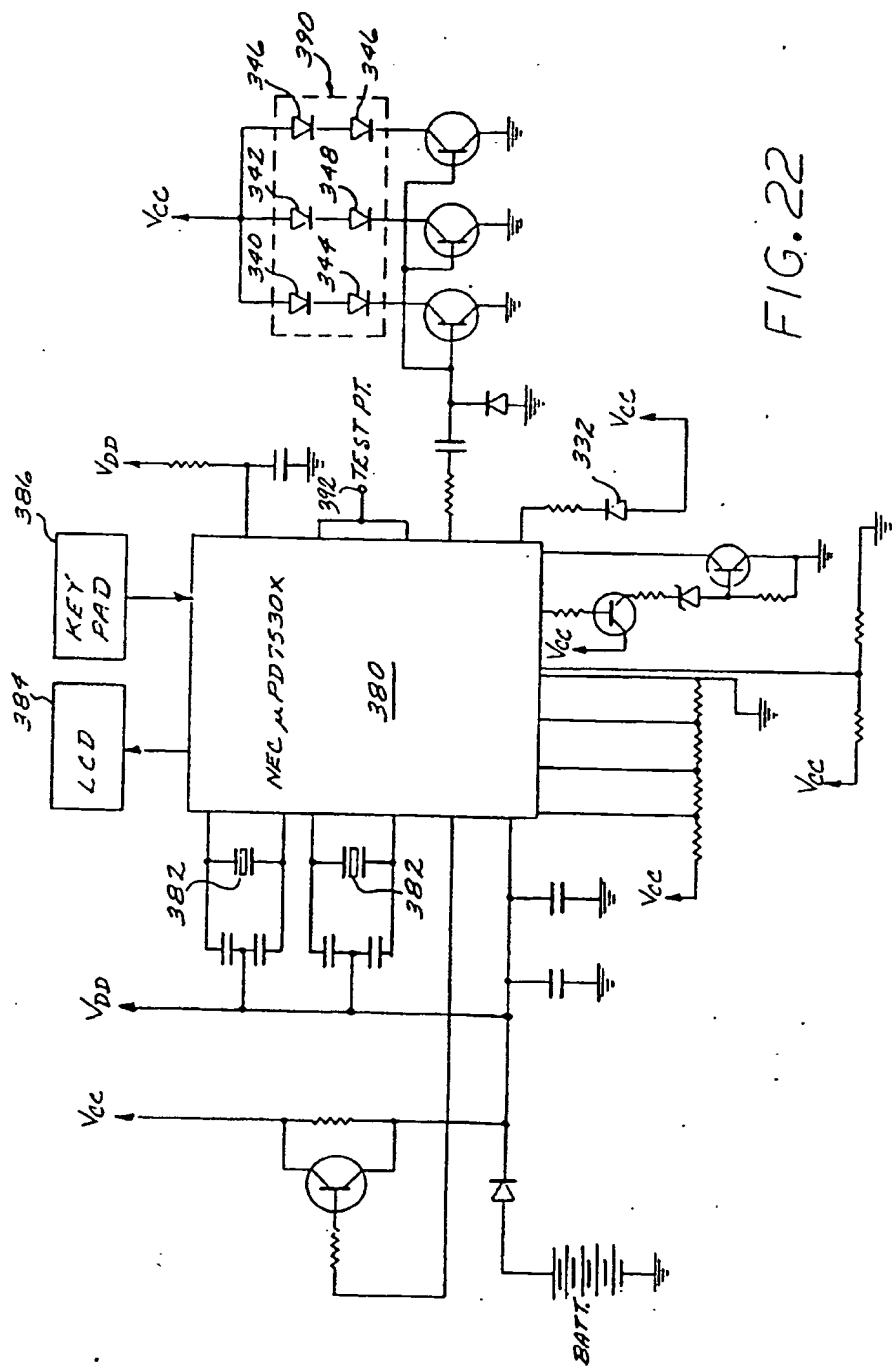


FIG. 22

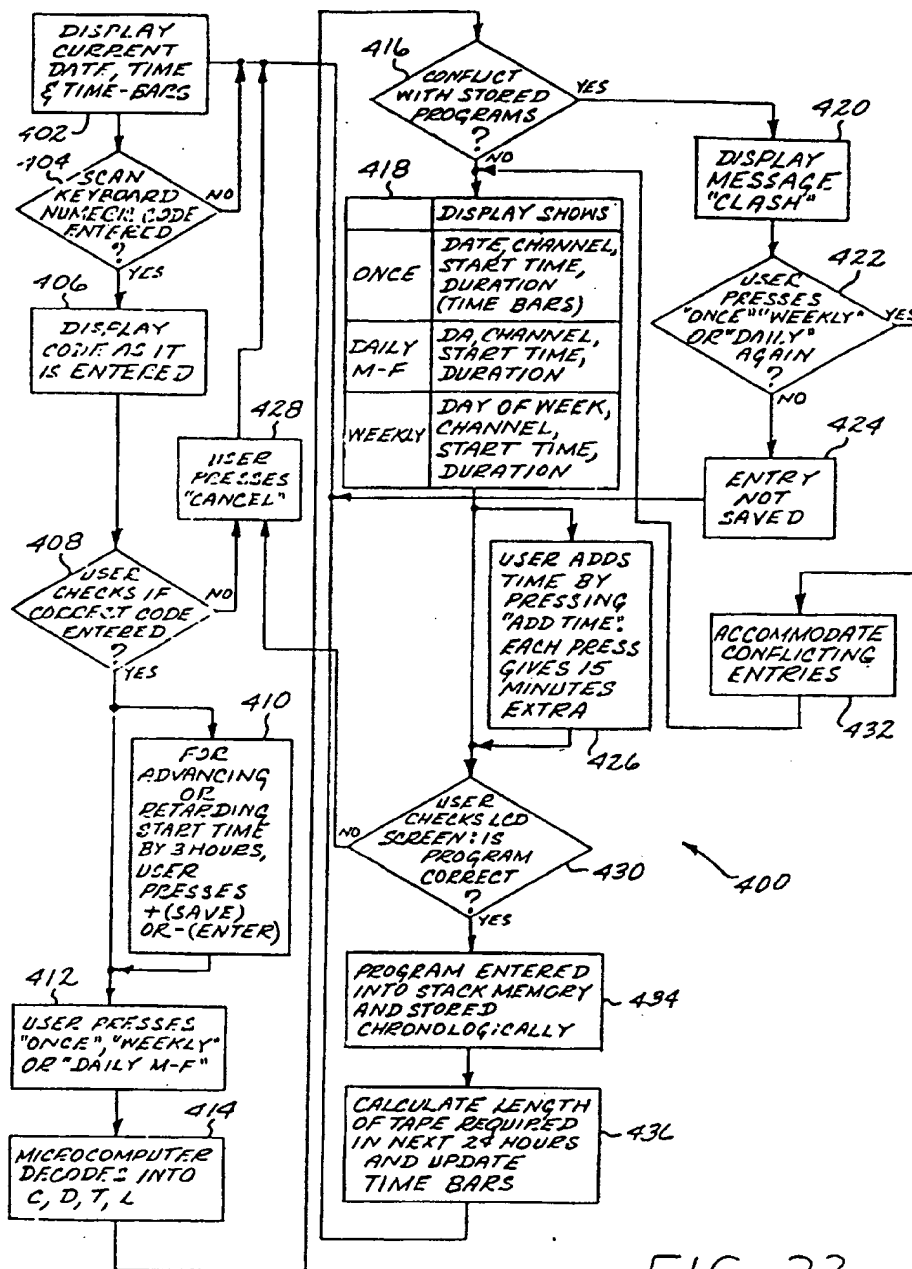


FIG. 23



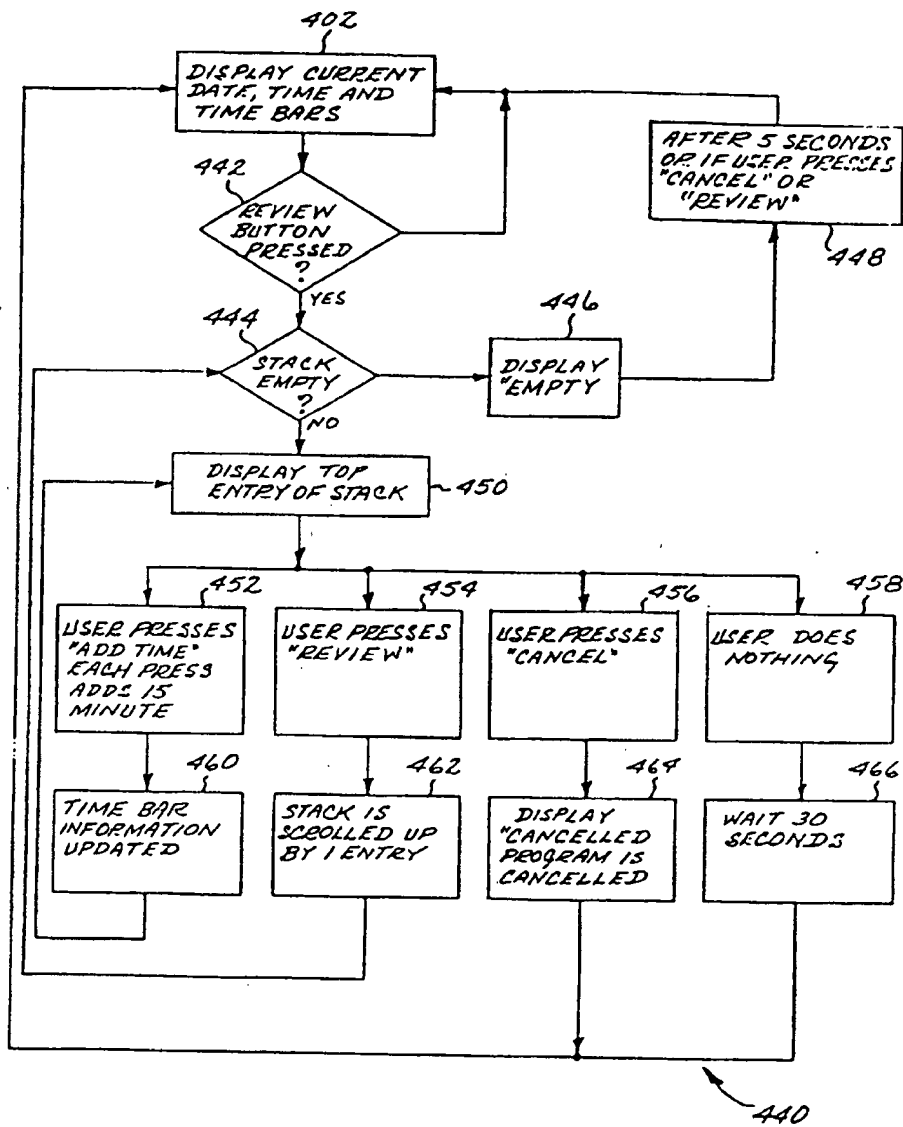


FIG. 24

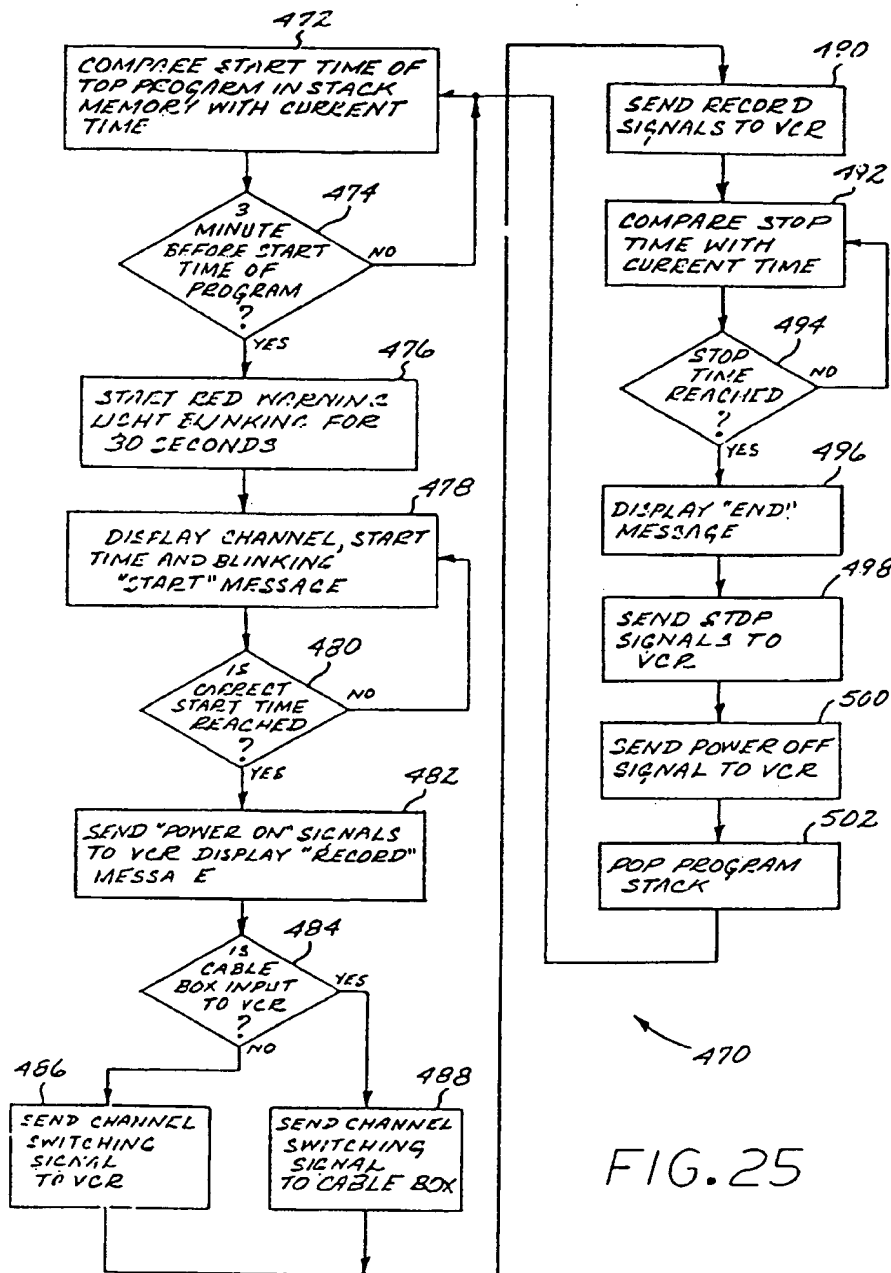


FIG. 25

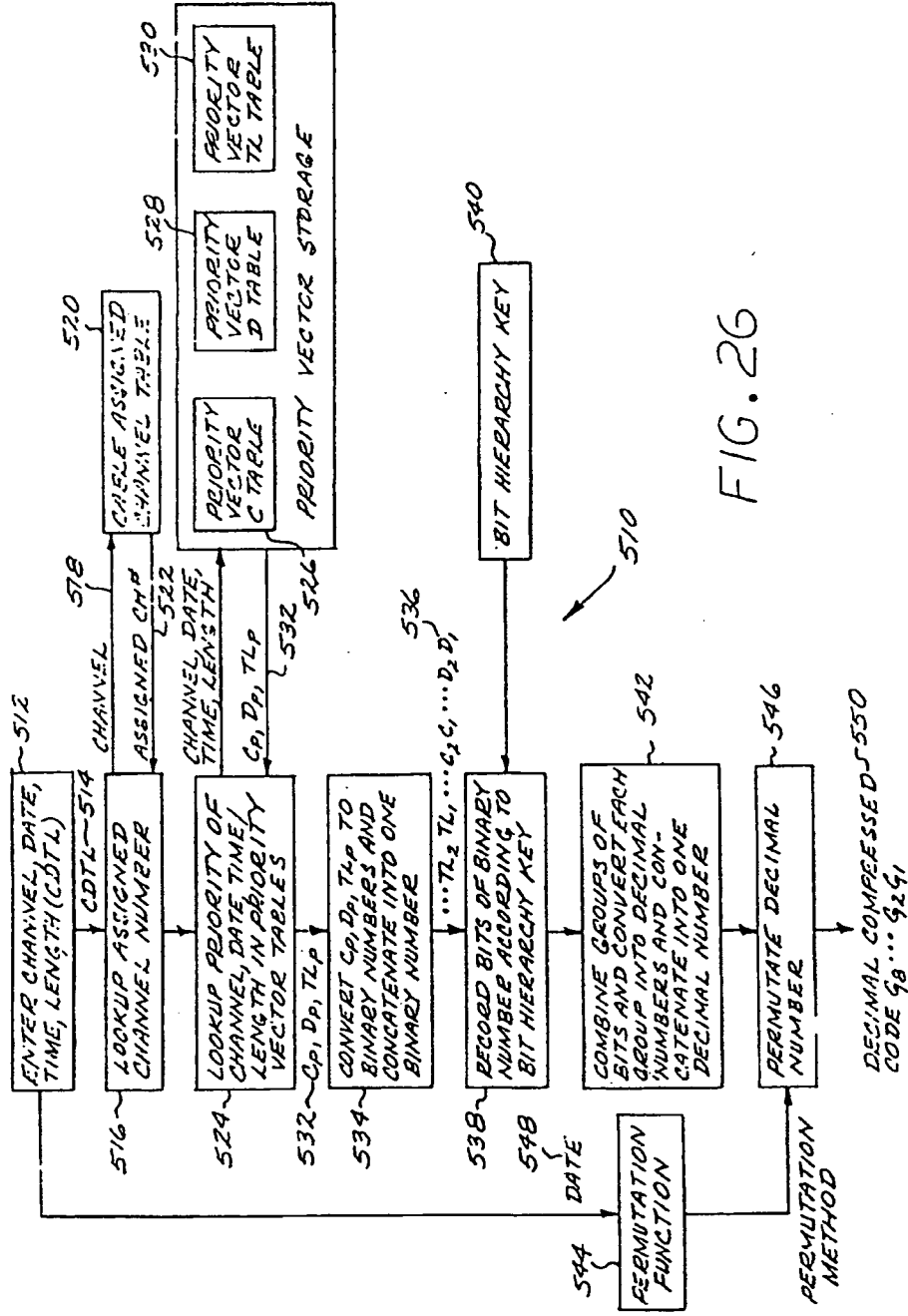
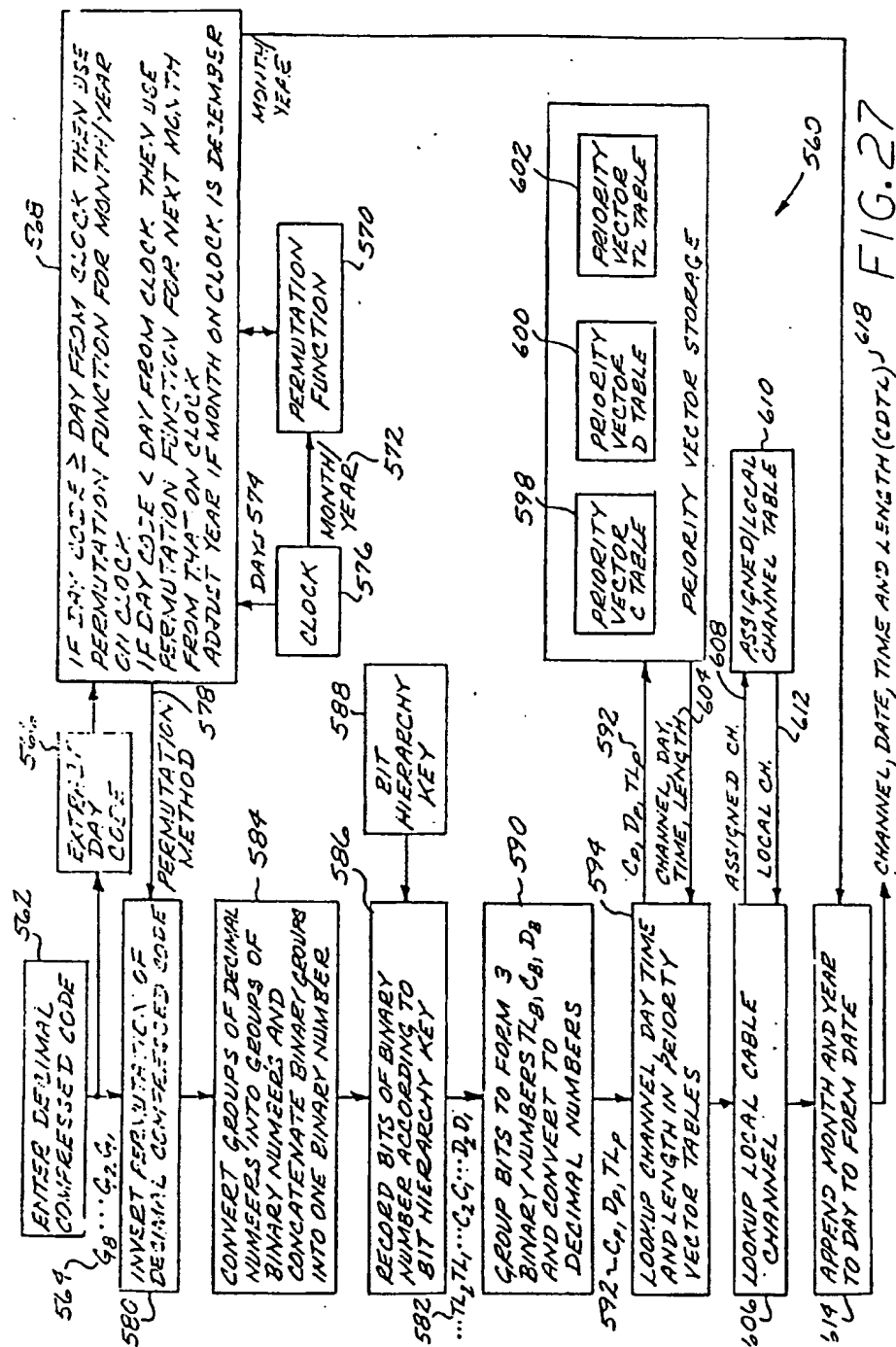


FIG. 26



	ASSIGNED CHANNEL NUMBERS	LOCAL CHANNEL NUMBERS
	GUIDE CH.	TV CH.
BROADCAST CHANNELS		
WBBM(CBS)	2	2
WMAQ(NBC)	5	5
622-WLS(ABC)	7	7
WGN	9	9
WTTN(PBS)	11	16
WPWR	50	45
WGBO	66	48
CABLE CHANNELS	629	
622-AFE	10	10
622-AMC	4	4
BET	25	8
BEAV	24	29
CNCB	36	36
CNN	13	35
CSPAN	27	30
DIS	23	25
ESPN	3	6

620

626

630

628

FIG.28

C

FIG. 29

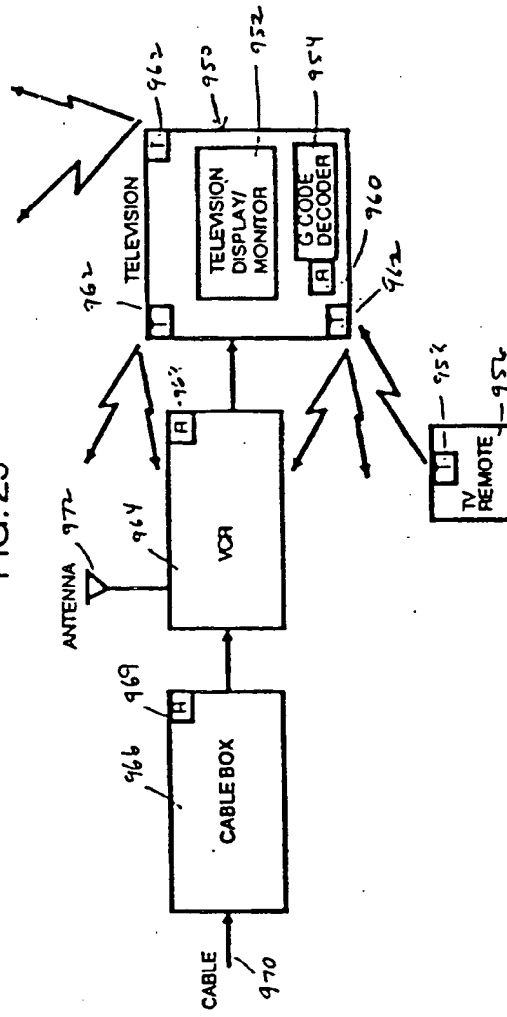


FIG. 30

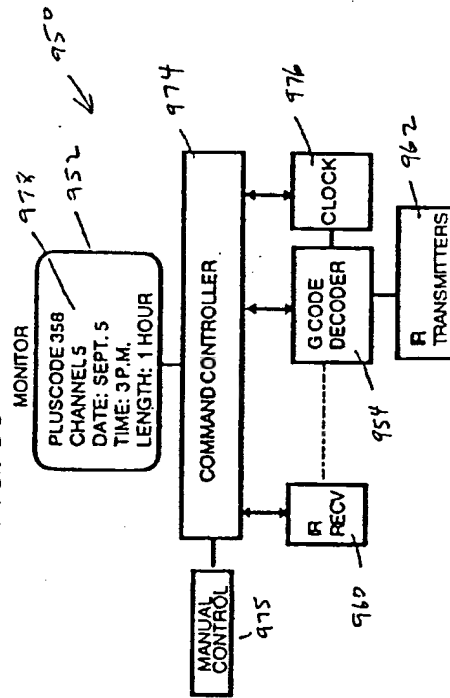


FIG. 31

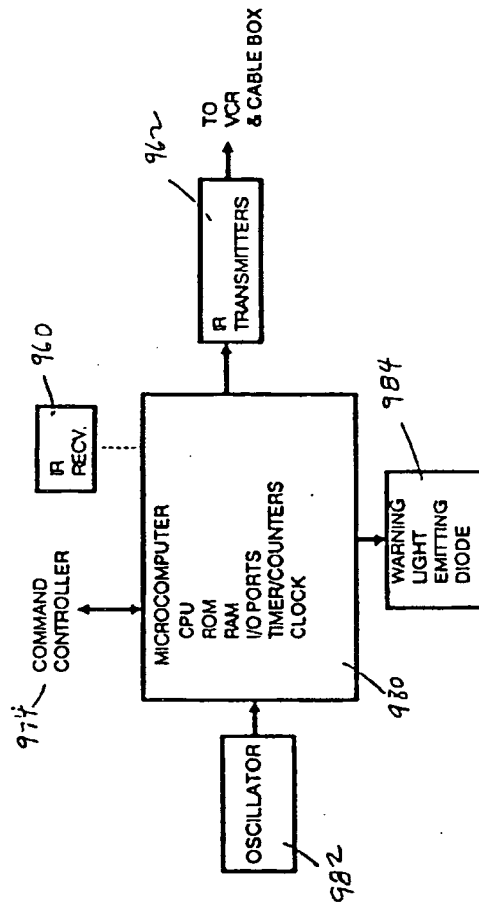




FIG. 32

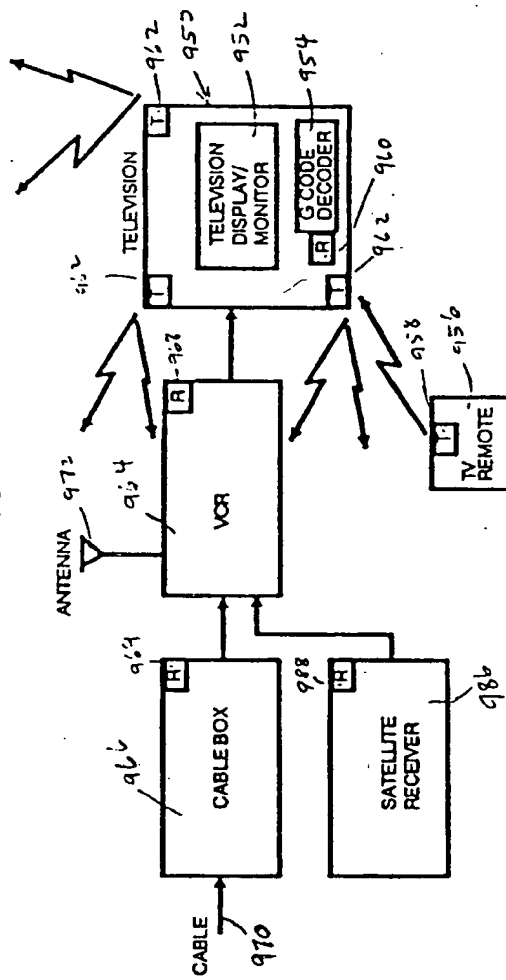


FIG. 33

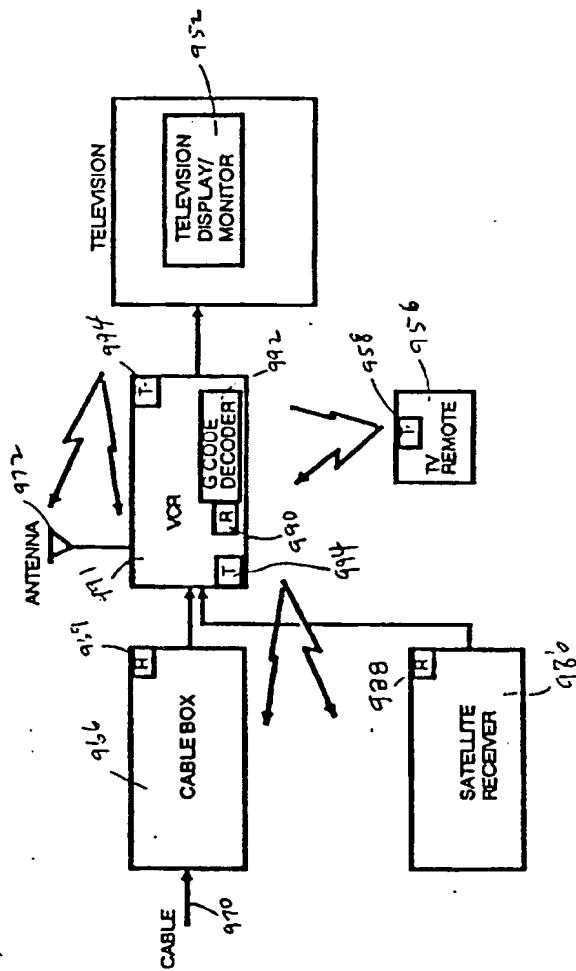


FIG. 34

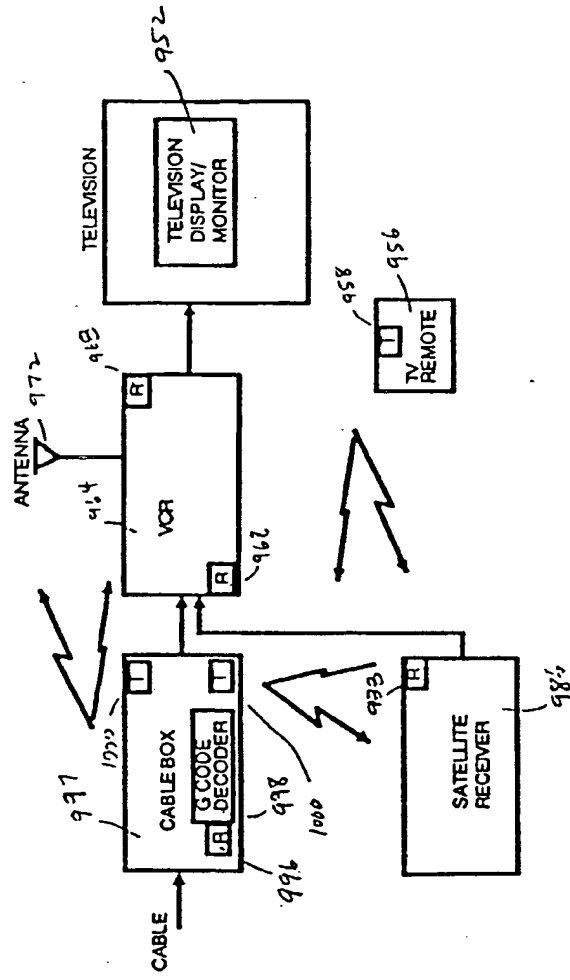
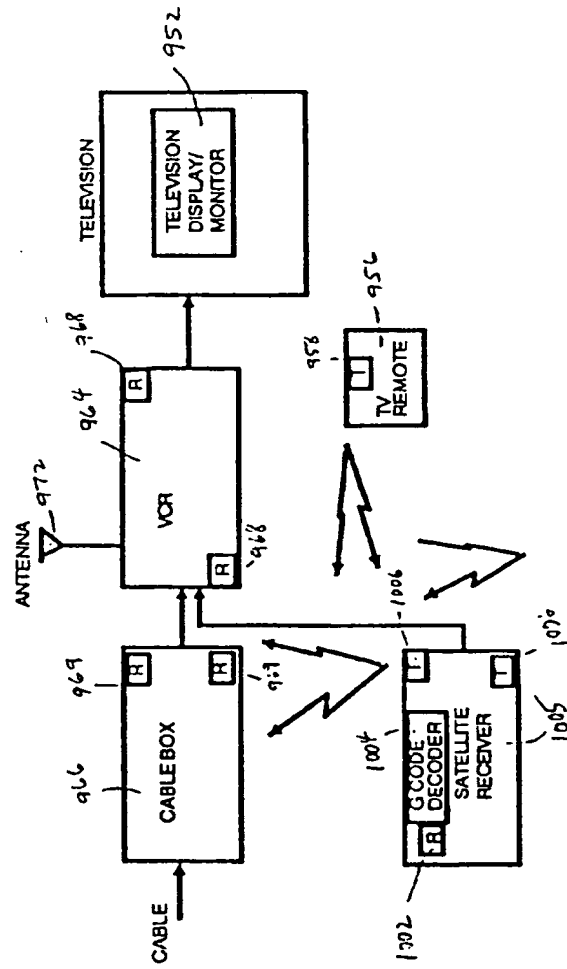


FIG. 35



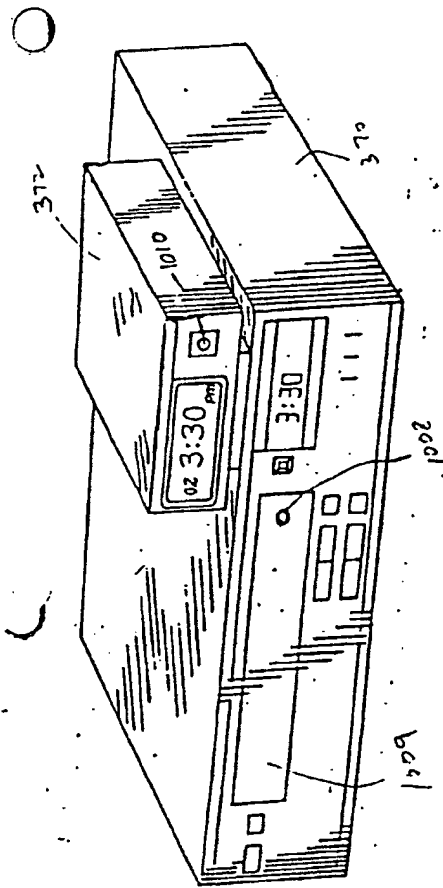


FIG. 36

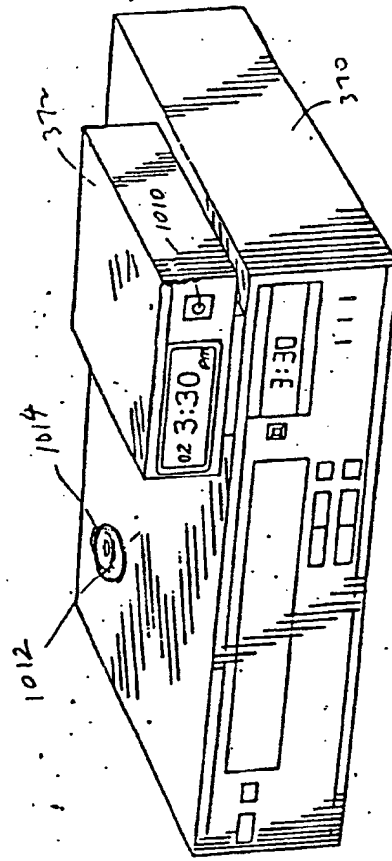


FIG. 37

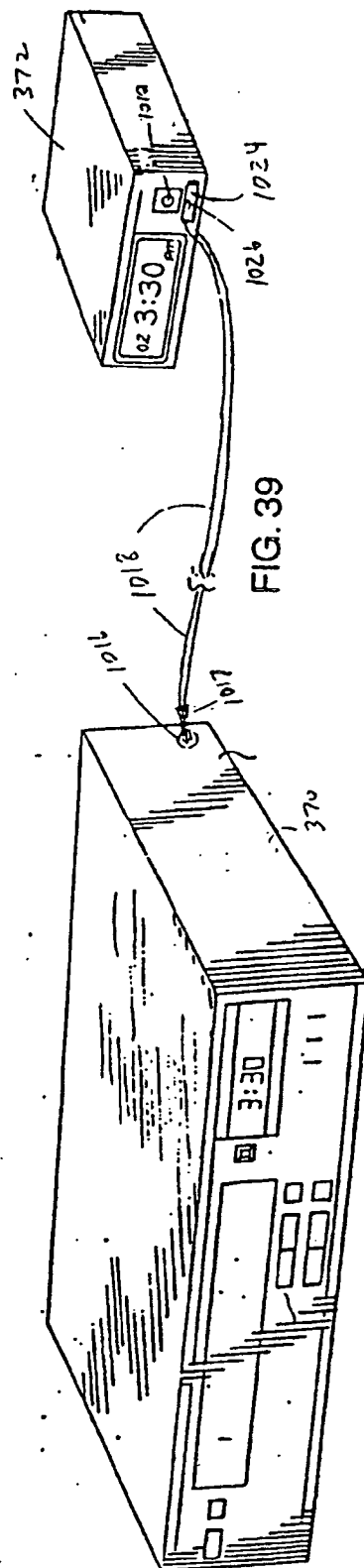
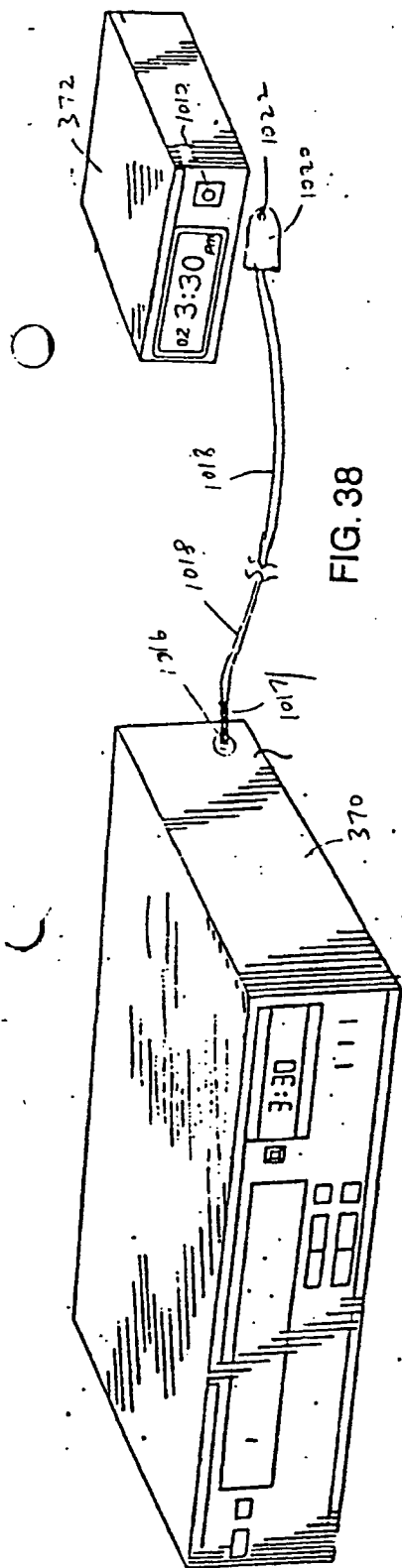


Fig. 10

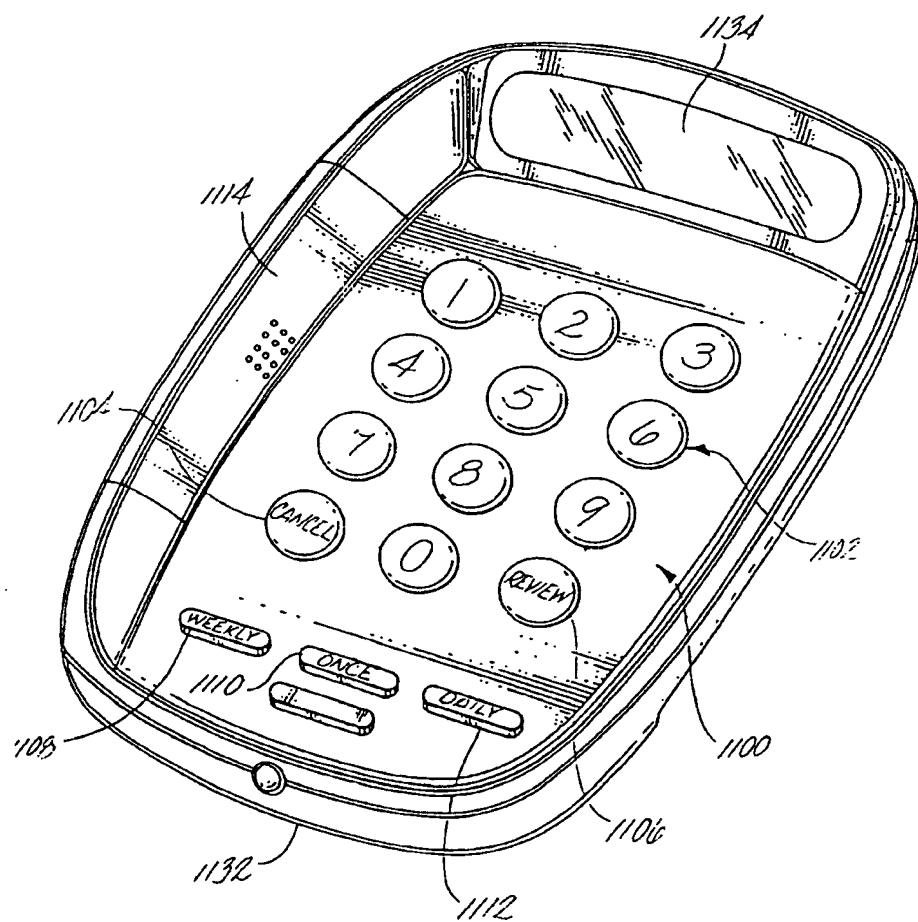
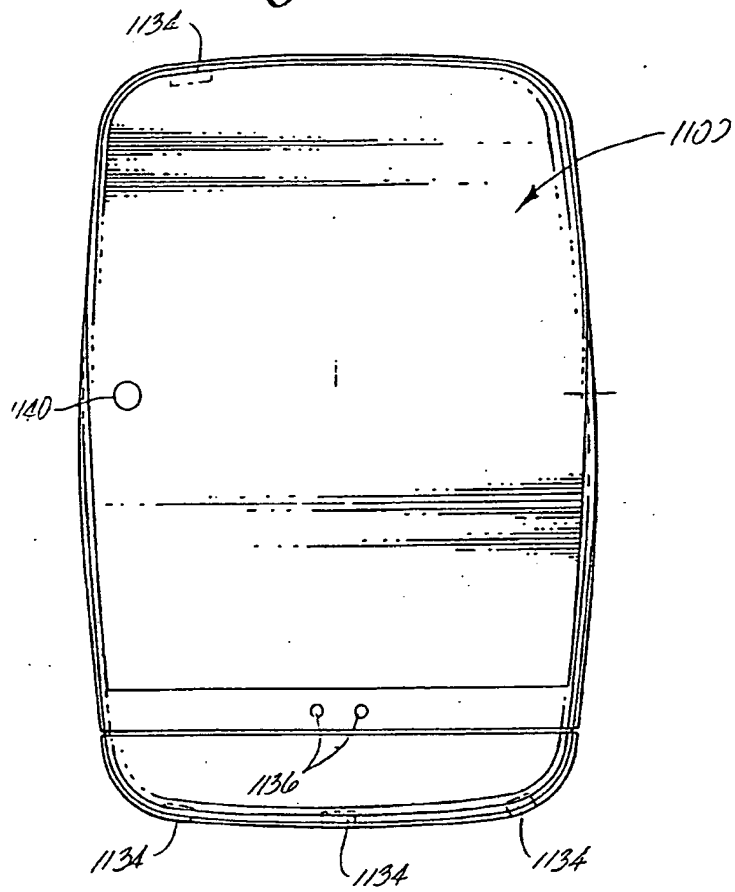


Fig. 41





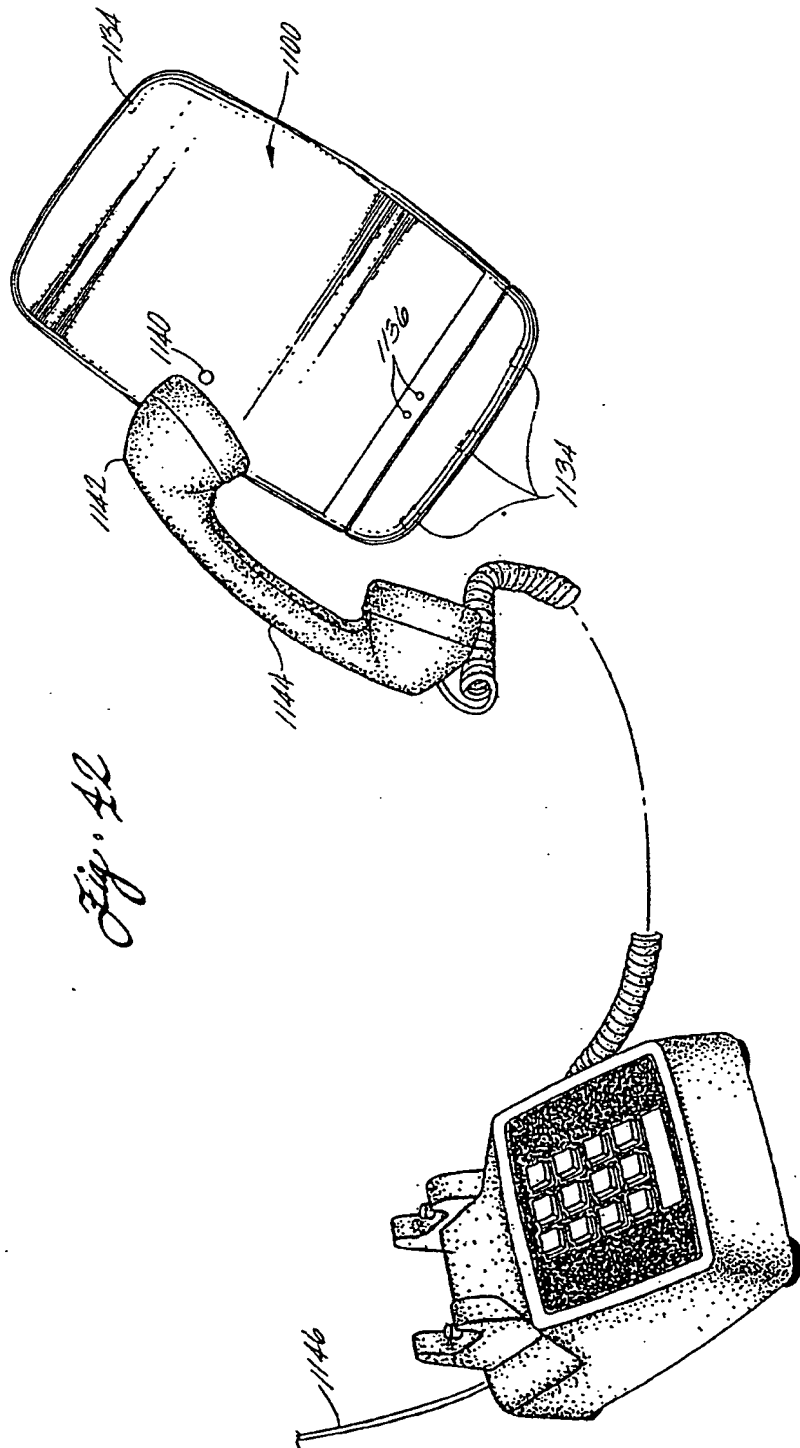


Fig. 42

Fig. 13

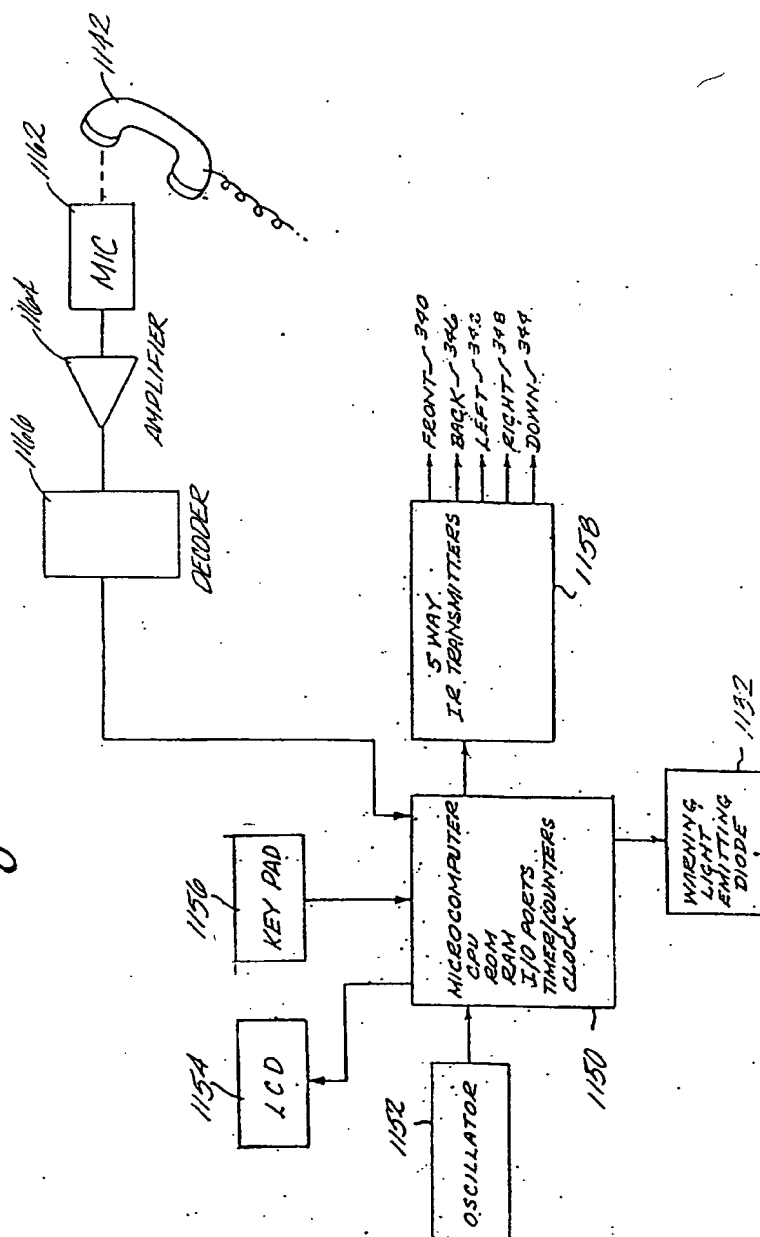
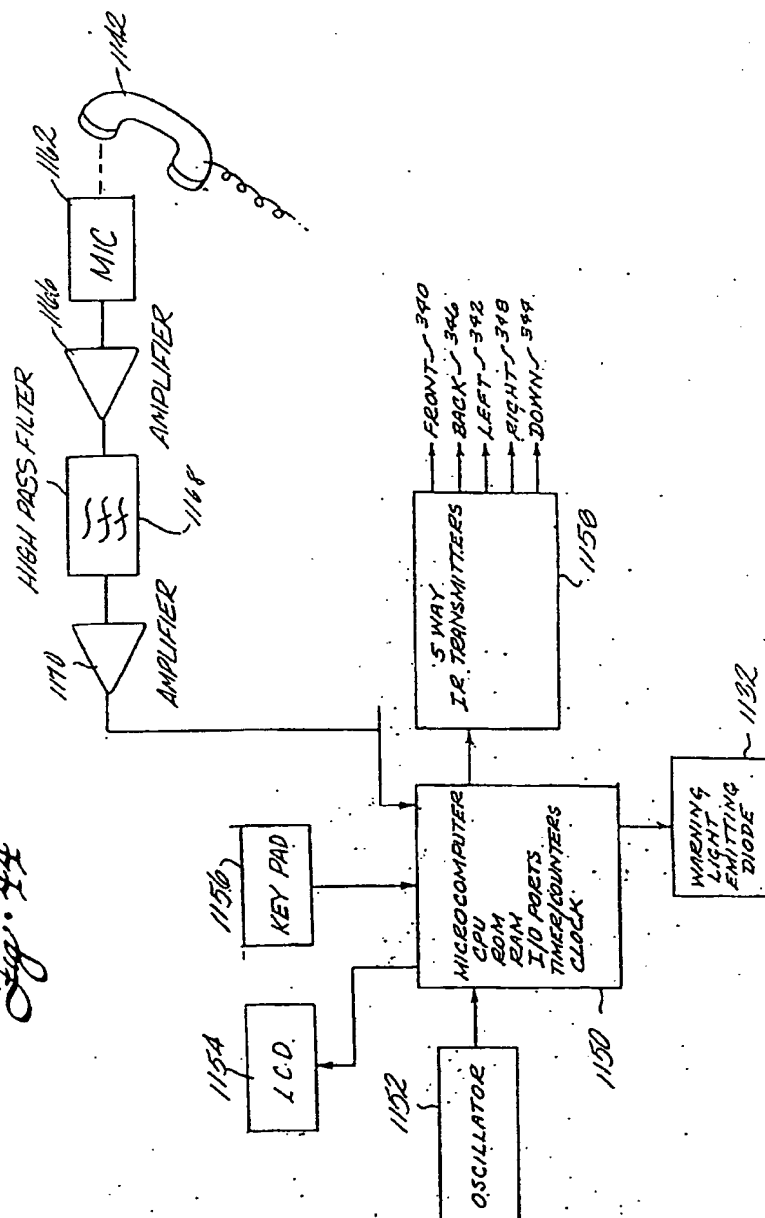


Fig. 44



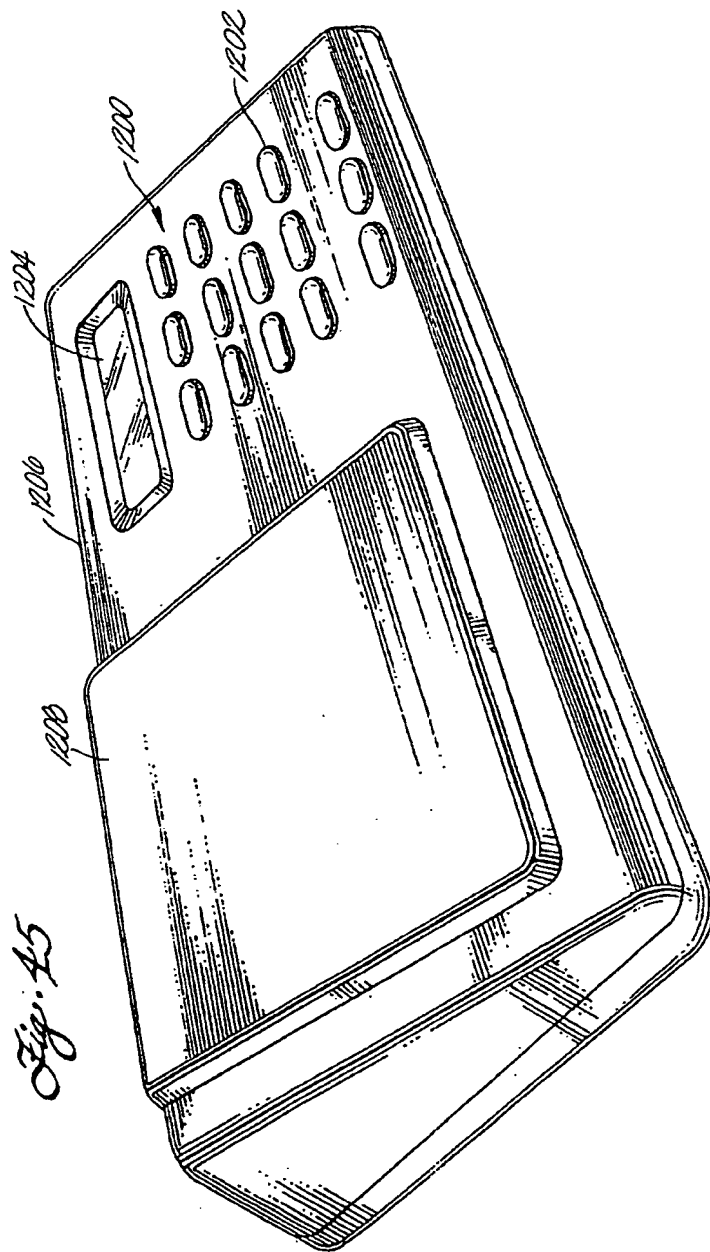


Fig. 45

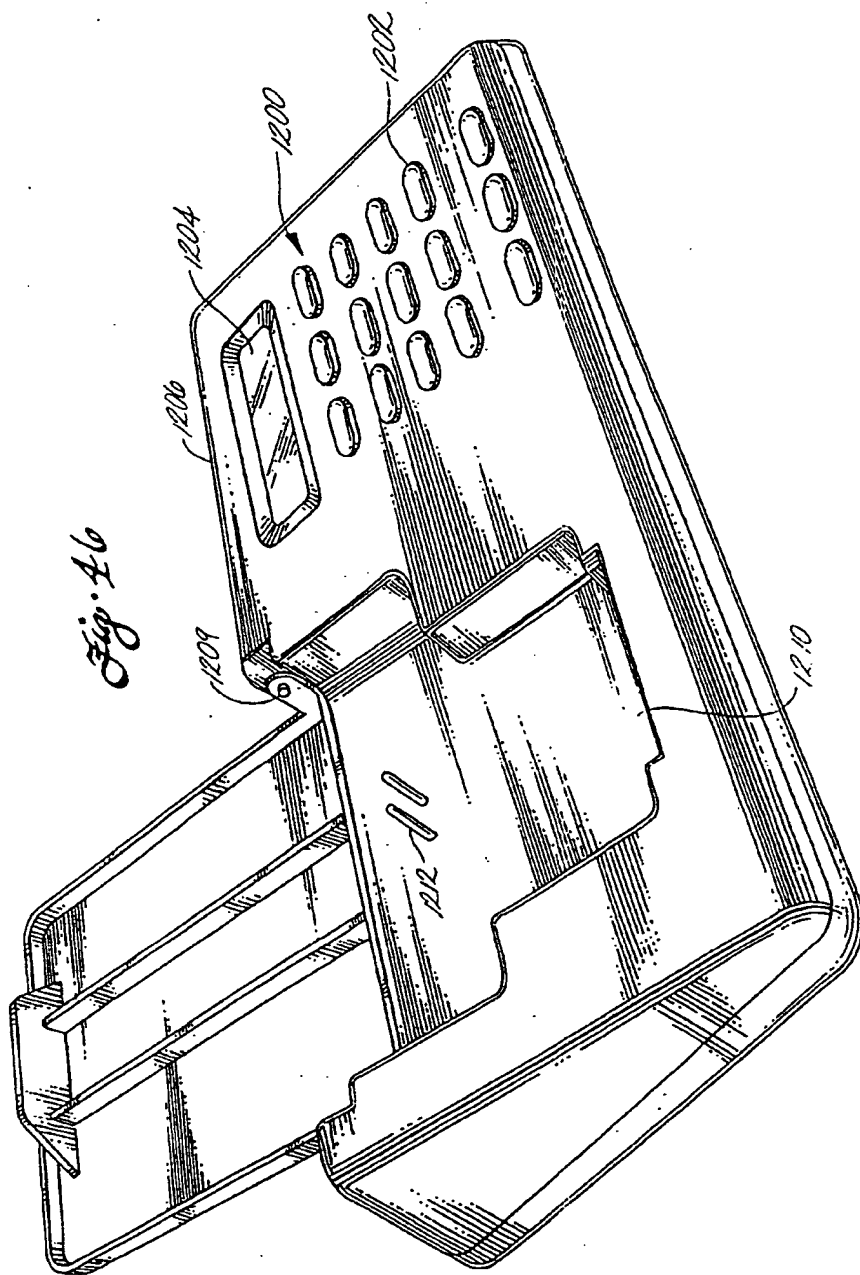
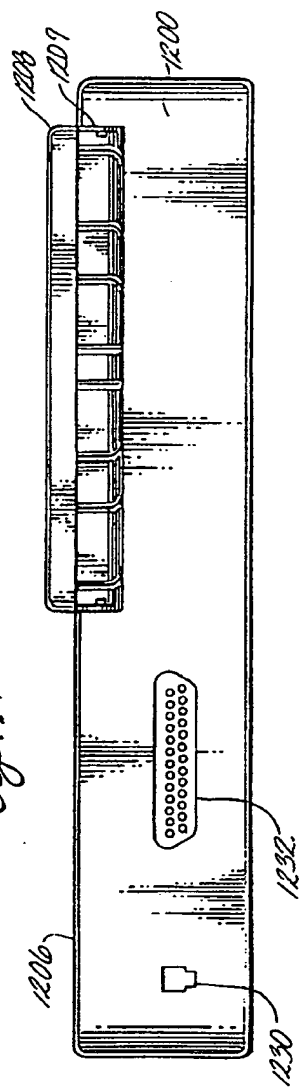
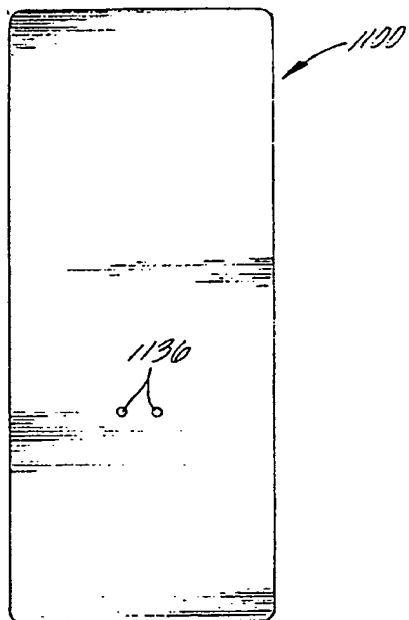
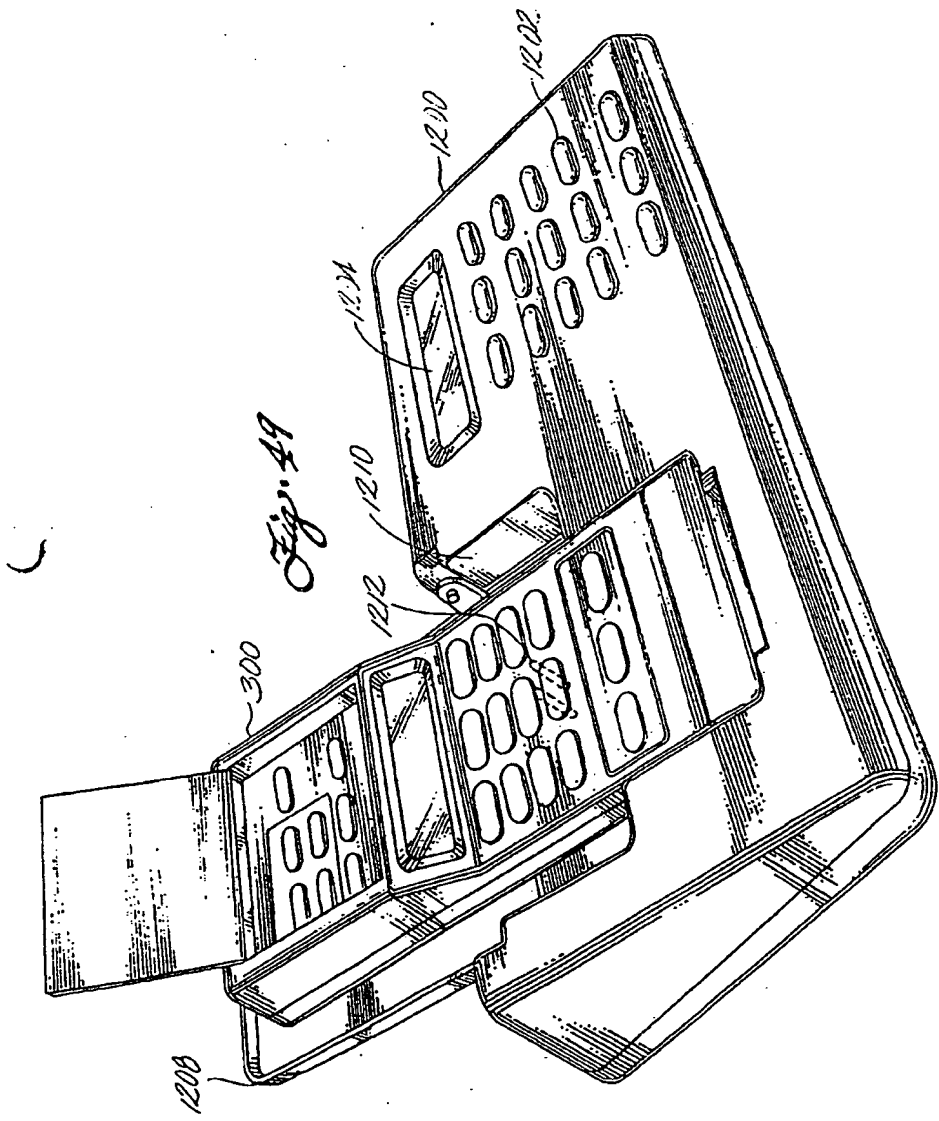


Fig. 47



*Fig. 40*







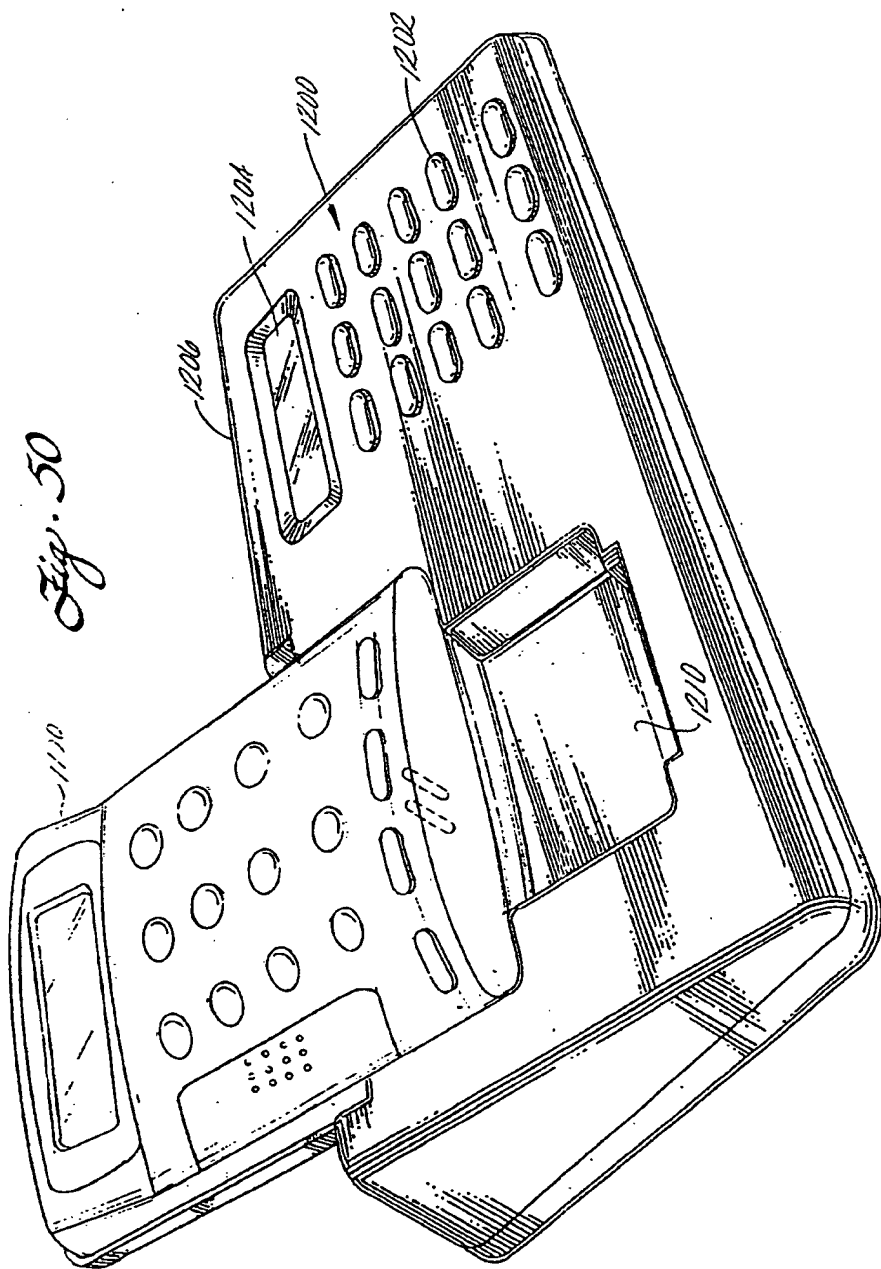
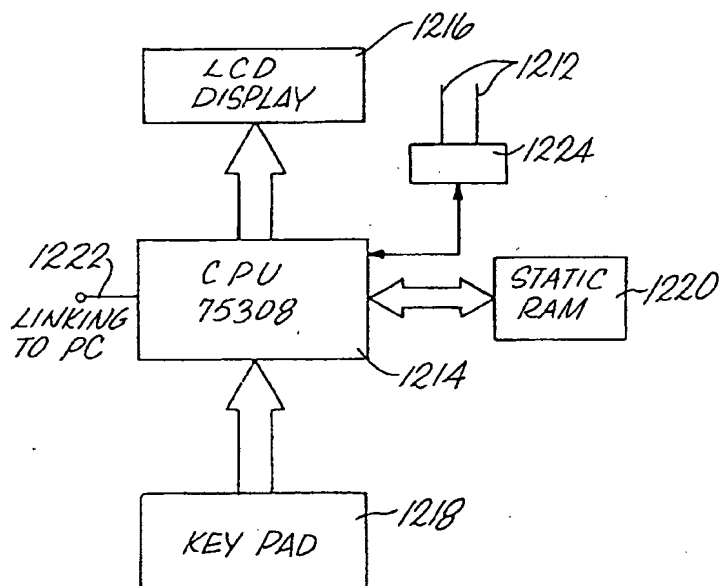
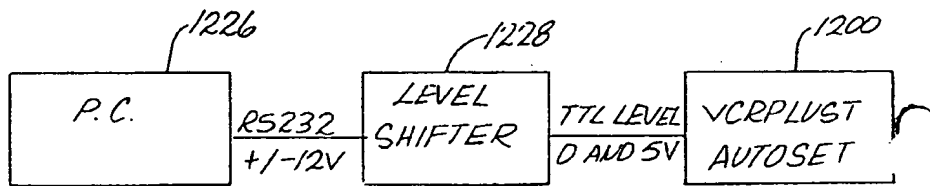


Fig. 50

Fig. 51



*Fig. 52*



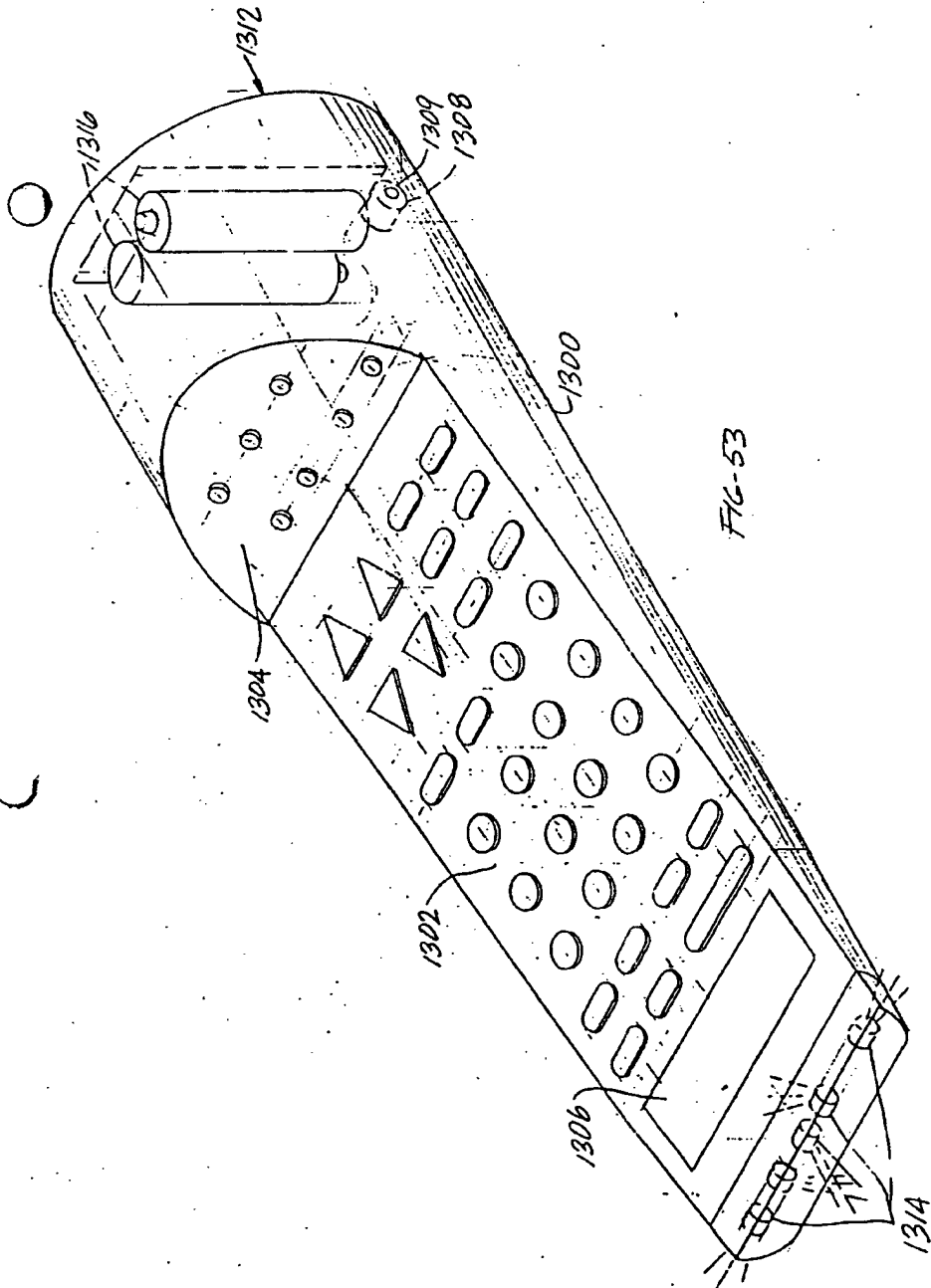


FIG. 54

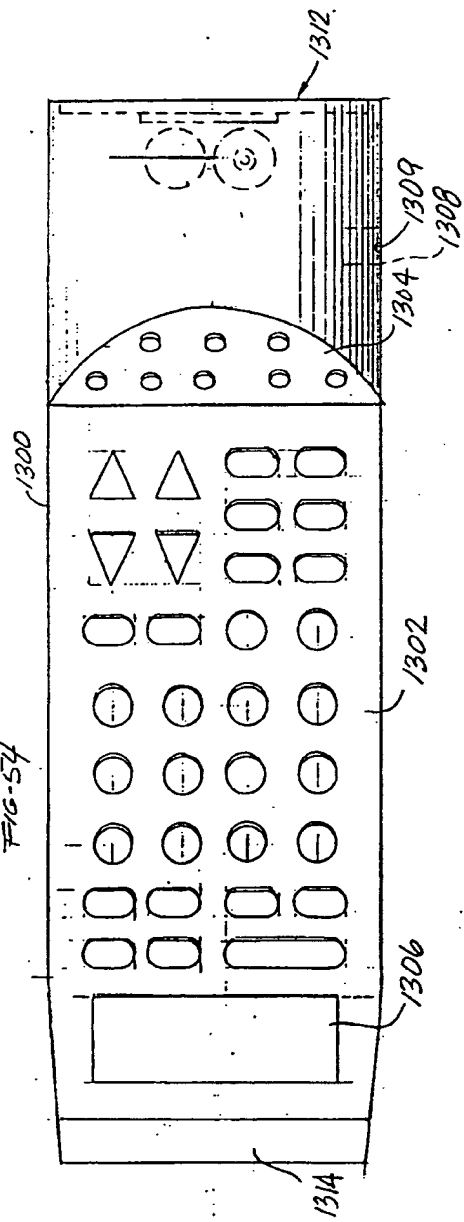
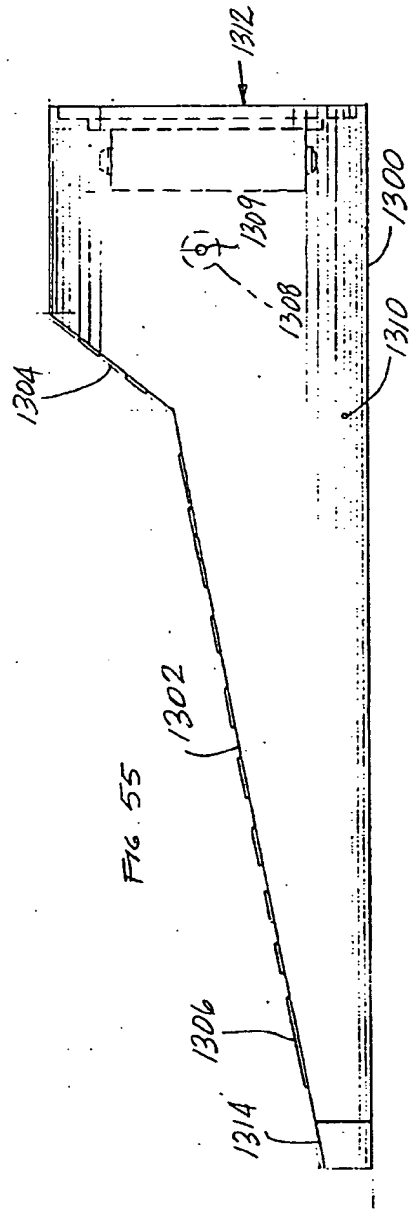


FIG. 55



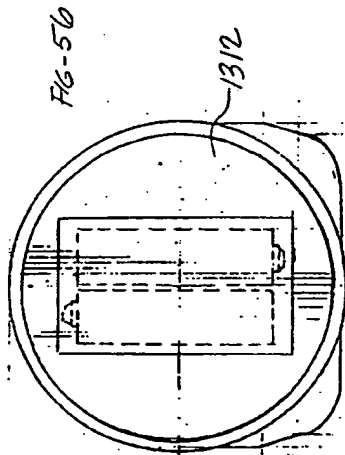


FIG-57

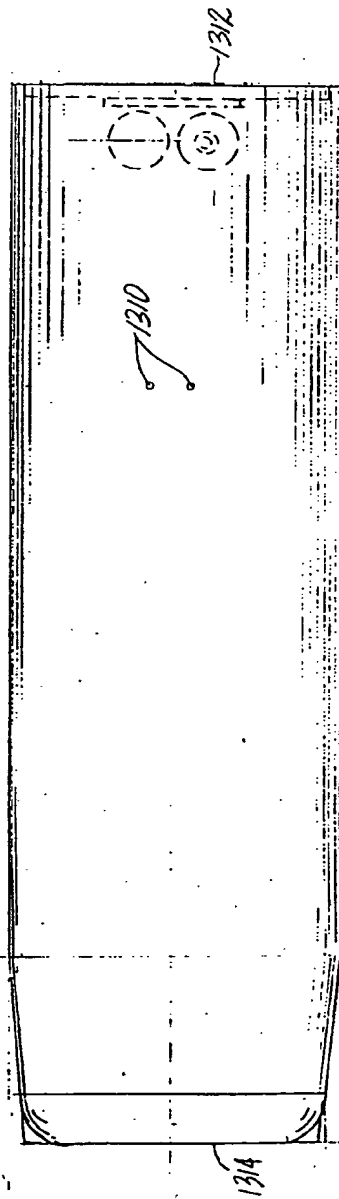
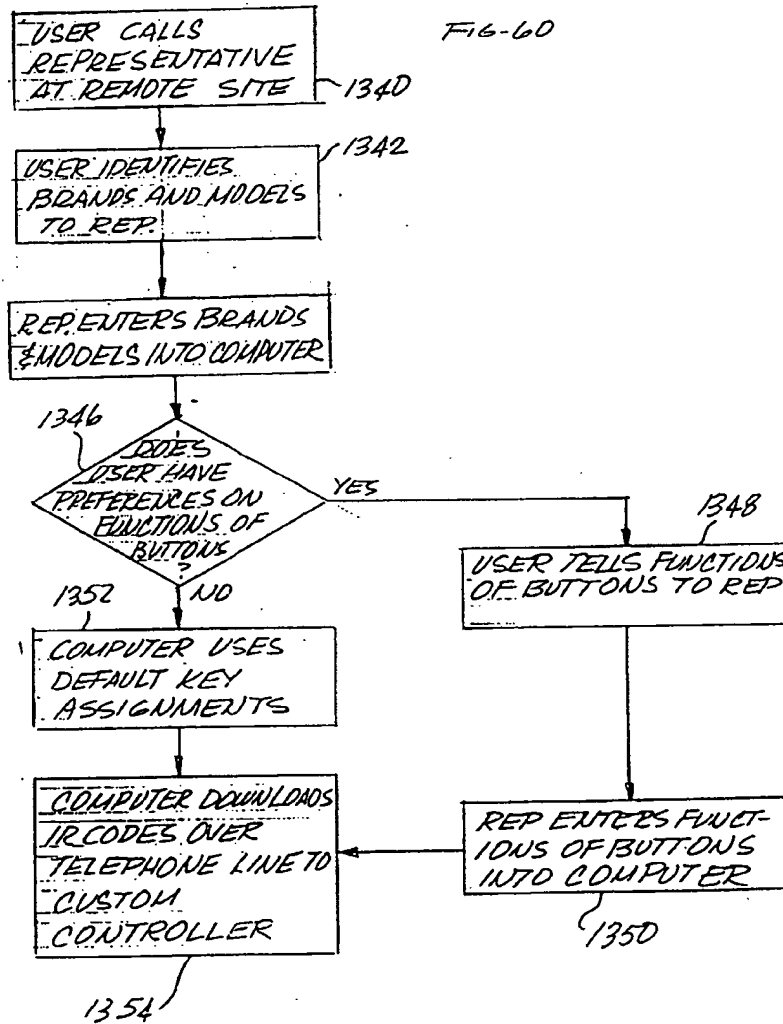
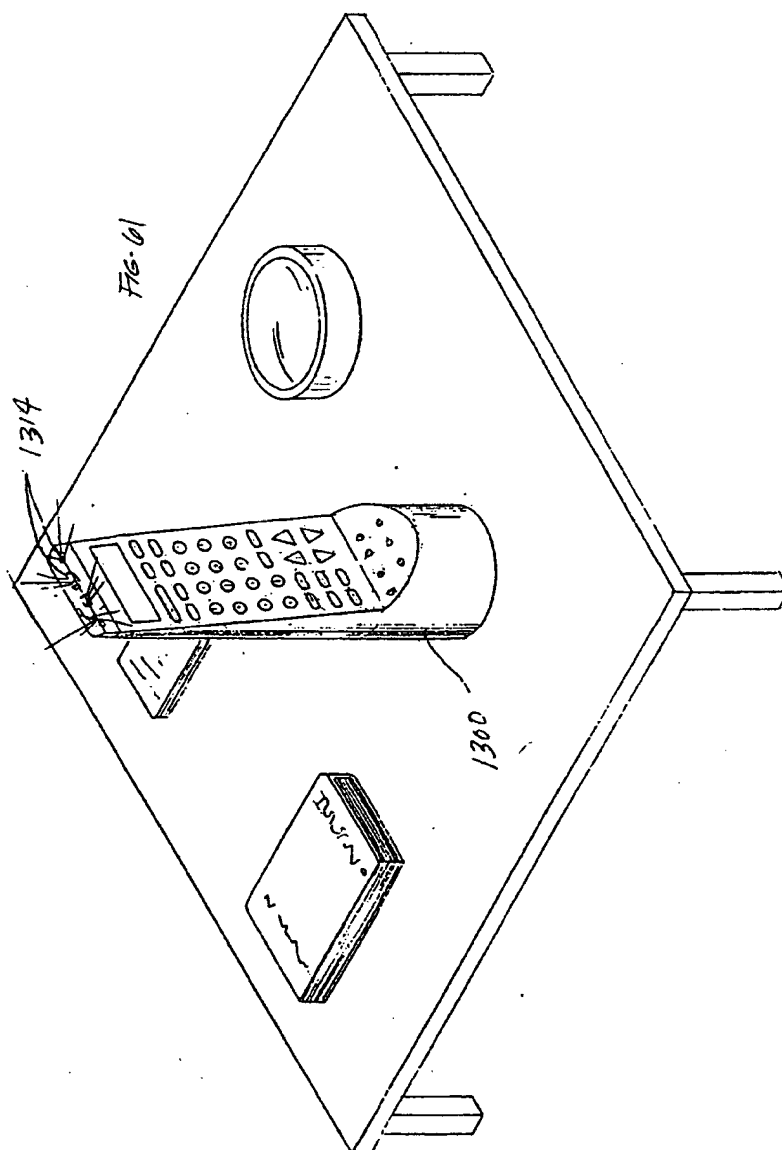


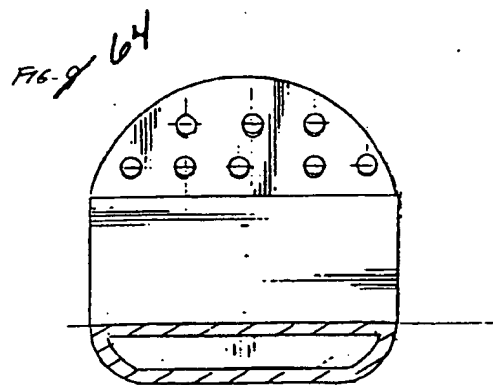
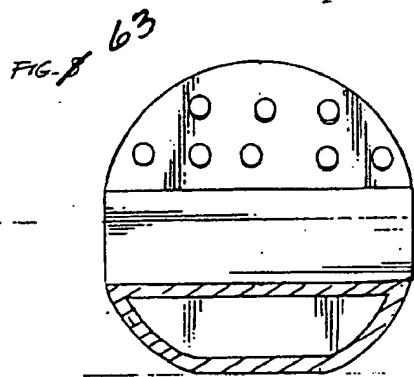
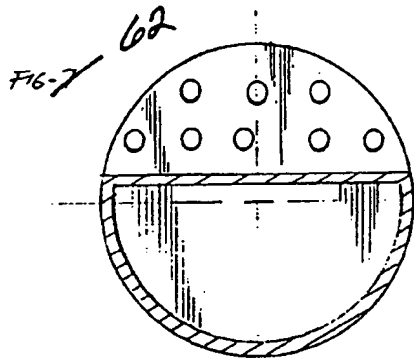


FIG-60









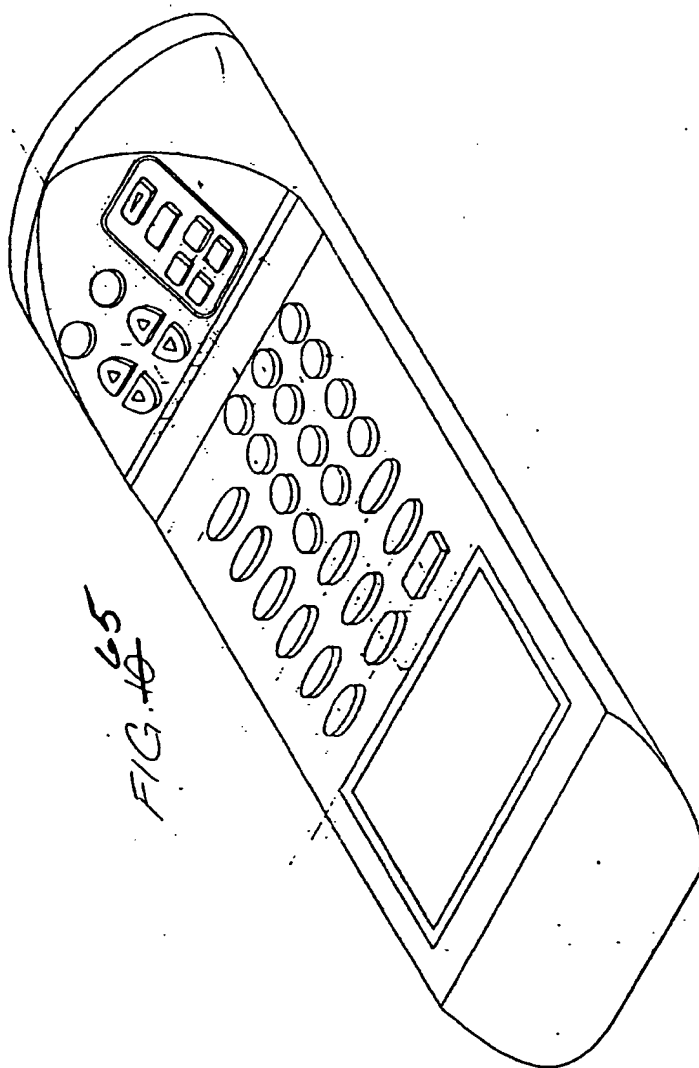


FIG. 65

C

FIG 4 66

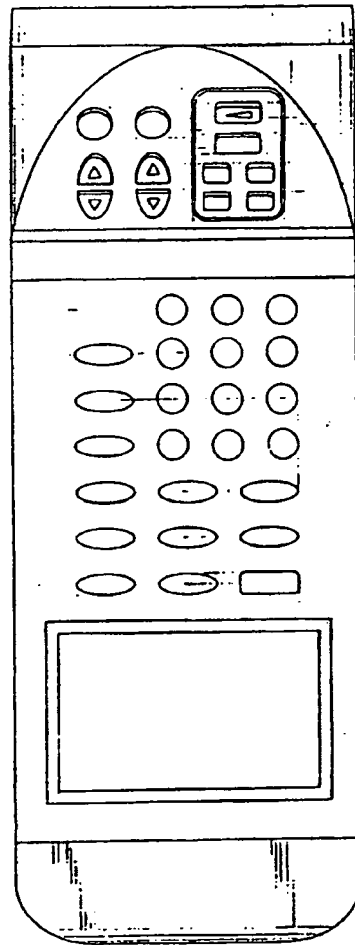
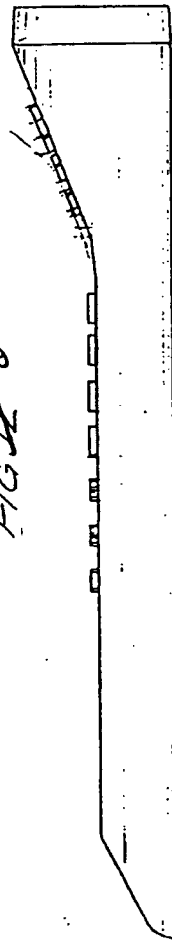


FIG 12 67



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FIG. 13 68

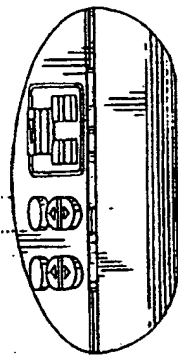


FIG. 14 69

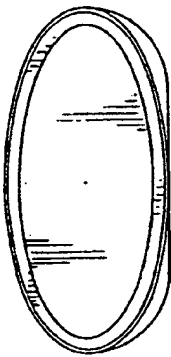
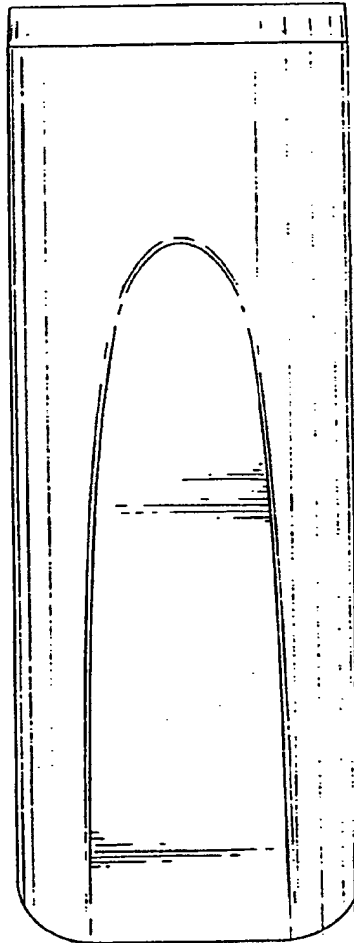


FIG. 15 70



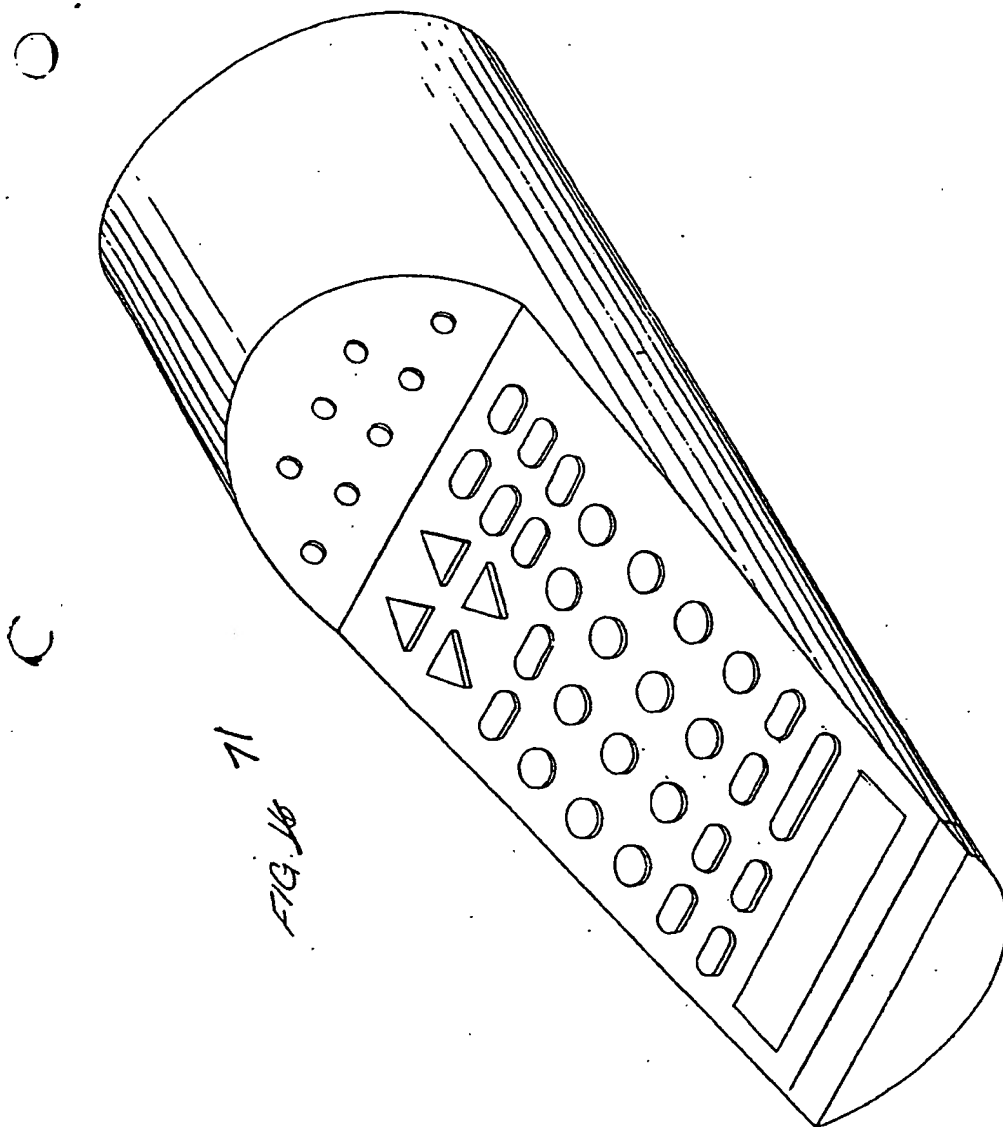


FIG. 16

C.

C.

FIG. 72

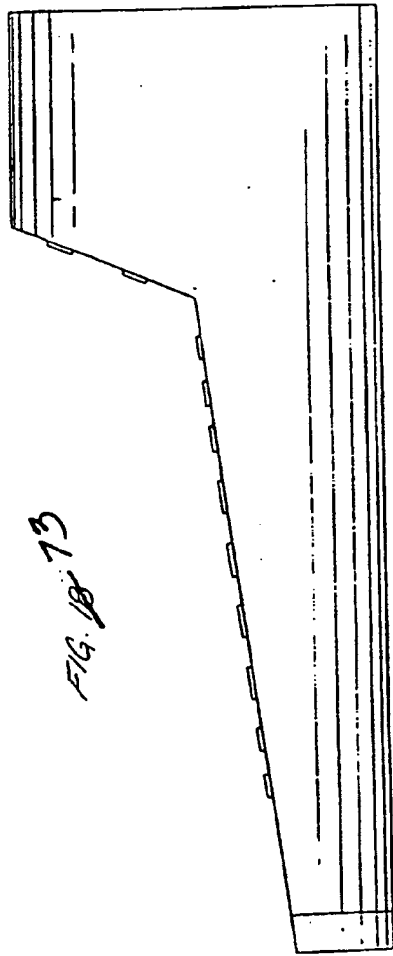
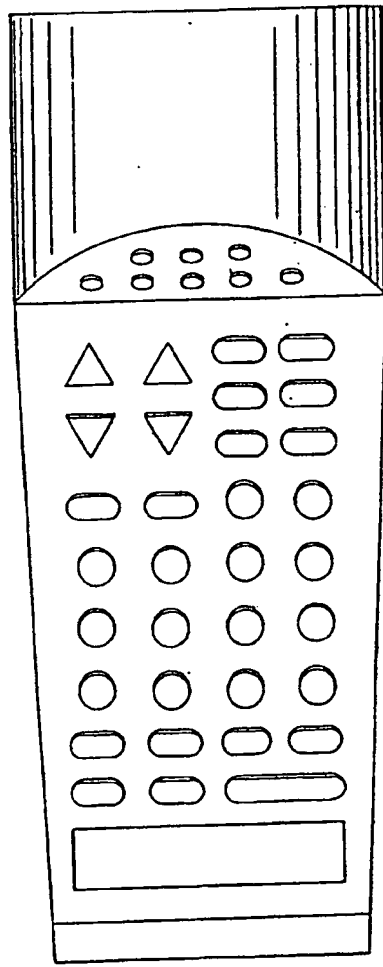


FIG. 73

